Industrial Medicine

for

Physicians and Surgeons in Industry

Volume 5 — MAY, 1936 — Number 5

THIS ISSUE

Injuries

—Abdominal Injuries — Injuries of the Kidney

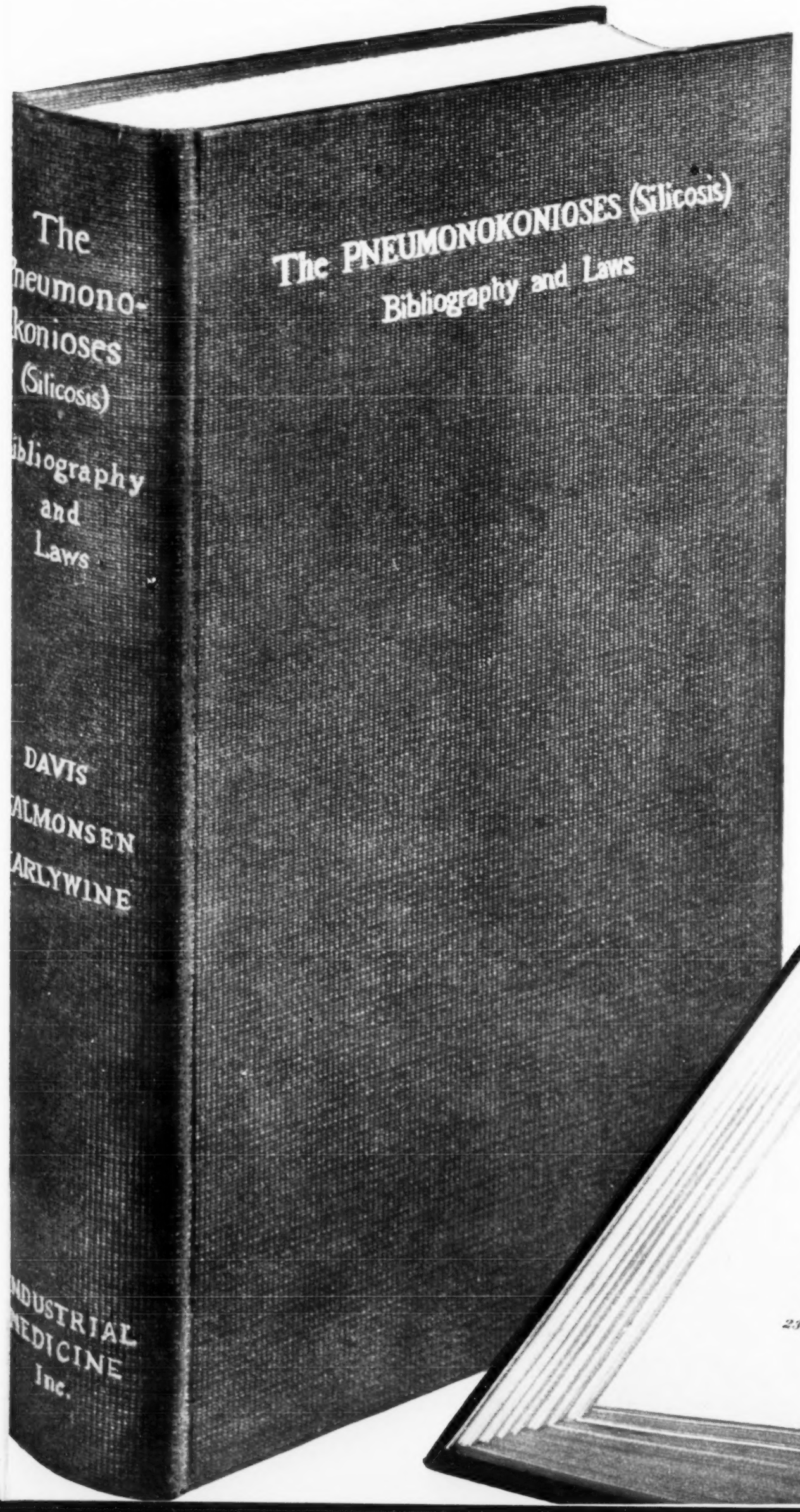
Dermatology

The Pneumonokonioses (Silicosis)

Bibliography *and* Laws Book No. 1

All the References of the World's Literature
--- from 1556 to December 31, 1933 ---

This Is a Book of References—it is not a Textbook—Its purpose is to put between two covers **all the references of the world's literature** on the Pneumonokonioses, so that anyone interested in the subject can quickly find out:
Who said **what**—and **when**—and **where**—
And to furnish easy access to the state law sections covering the industrial regulations.
This Book does just that.
"The Pneumonokonioses" is a **Source** book, in compact, convenient form. The editors, sensing the great need for such a comprehensive, handy reference, have produced a work which already has earned the thanks of professional men from coast to coast.



The Editors

George G. Davis, M.D., Associate Professor of Surgery at Rush Medical College, University of Chicago; Attending Surgeon Cook County Hospital.

Joseph L. Earlywine, Attorney at Law, Chicago. Both Dr. Davis and Mr. Earlywine are well known throughout the middle west from years of honorable medicolegal service.

Ella M. Salmonsen, Medical Reference Librarian at The John Crerar Library, Chicago. Physicians and students of medicine have been familiar with her efficiency at the library for many years.

Contents: Sec. I—Bibliographical References 1556-1933; followed by Subject Index, Author's Index, Index of Reference Group Headings, and Reference Index. Sec. II—Laws of the States—Leading Cases.

Handsomely bound in cloth; convenient size; well printed on high-grade book paper—6 x 9; 482 pp. Price $7.50 postpaid.

CHICAGO MEDICAL PRESS
(NOT INC.)

302 South Canal Street,

Chicago, Illinois

This magazine is published to promote sound thought upon and concerning industrial medicine and traumatic surgery. To that end it will contain articles, news items, reports, digests and other presentations, together with editors' comments. The editorial policy is to encourage frank discussion. On this basis contributions are invited.

Industrial Medicine

Reg. U. S. Pat. Off.

The editors will exercise care in checking on the accuracy of data printed, but in all other respects articles and opinions of which expression is allowed are the opinions of their authors—the editors reserving in all cases the right to comment on the same, in the current or any subsequent issues, as they may be inclined.

The Journal of Traumatic Surgery and Occupational Diseases

The Law, the Science and the Economics of Industrial Health

Volume 5 MAY, 1936 Number 5

The Proper Study of Mankind is Man

by

J. R. GARNER, M.D.,
Chairman, Medical and Surgical Section, Association of American Railroads; Chief Surgeon, Georgia Railroad, Atlanta & West Point Railroad, and Western Railway of Alabama

ALEXANDER POPE'S classical "Essay On Man," a quotation from which has been selected as topic for this occasion, was written in 1734. Some 60 years later Watt made the first practical application of the principles of steam to an engine. Almost another half century elapsed before the first steam railroad was actually operated: in 1830, the "Best Friend" was introduced to the world by the Baltimore & Ohio Railroad. From then until now railroad construction has increased, and today every known part of the civilized world has been traversed by the rails which truly constitute the aorta of commerce.*

While operation of the primitive locomotive, with its slow speed and short distances to travel, was doubtless a relatively simple matter, this cannot be said with reference to the ponderous Moguls of today which attain high rates of speed, bringing distant cities within a few hours of each other.

Man power is, and must ever be, an essential to railroad operation. Since this is true, it is both reasonable and wise that as great care should be exercised in the selection of railway employees as is displayed in the purchasing of equipment. Only those physically and mentally fit should be selected, and to this end the American Railway Association in 1925 adopted a standard of physical requirements, compiled by this, the Medical and Surgical, Section. Under these regulations governing the physical examination of applicants for employment, 163 physical defects, classified under 15 distinct headings, are listed as causes for rejection.

No railroad would purchase a locomotive or a train, consign it to the ravages of time, usage and wear, and give no thought or attention to the correction of incipient defects as they may arise. Your locomotive is placed in the hands of experienced enginemen for operation, but at the end of each run it is carefully inspected by trained mechanics and any defect found is corrected. Scarcely do the wheels of our trains cease to turn on arrival at a terminus before trained inspectors are energetically at work seeking the detection of defects that may have developed enroute. Even the rails are constantly inspected and their efficiency maintained by replacements or correction of defects. With reference to material and equipment we find inspection, inspection, inspection every day, all the time. But often there is failure to inspect the human body and brain, commodities which cannot be purchased, but upon which reliance must be placed for the important work at hand. We recognize depreciation in the inanimate factors connected with our operations, but we frequently fail to take cognizance of the human depreciation which is, if anything, more vital. We inspect our material contrivances, which are relatively well known, while failing to inspect the human element,—which Alexis Carrel has so properly termed—"Man, the Unknown."

No matter how physically perfect the new employee may be, time and the ills that flesh is heir to bear down upon him with disquieting results. Early detection of these changed conditions and institution of proper remedial measures, will more often than not restore the individual to a physical fitness resulting in added years of useful and efficient service.

YOUR Committee on Disability and Rehabilitation has done a very efficient work in the study and presentment of the several maladies most disturbing to the efficiency of railway man power. They have gone into much detail with reference to malaria, diabetes, syphilis, cardiovascular-renal disease, and other conditions, pointing out the hazards and outlining safe courses of procedure tending to an improved physical status of the affected person and a prolongation of his usefulness and service.

The Committee on Developments resulting from Physical Examinations have devoted much time to considering the statistics submitted by railroads which have instituted periodic physical re-examinations. A study of their various reports reveals

* Chairman's Address, at the Meeting of the Medical and Surgical Section of the Association of American Railroads, Chicago, May 11-12, 1936.

a marked improvement in the physical status of the railroad man power of such lines.

Occasionally objection is raised to re-examination by some employees who fear removal from service as a result of defects which may be disclosed. They lose sight altogether of the fact that the great majority of defects are either remedial or improvable. For substantiation of this, your attention is directed to the defects found as the result of the examination of 12,000 employees:

Defective vision	309
Defective color perception	49
Defective hearing	52
Heart lesions	68
Hypertension	937
Hypotension	53
Pyorrhea	1,387
Dental caries	720
Tonsils	1,053
Thyroids	143
Overweight	1,161
Underweight	152
Hernias	118
Varicose veins	65
Diabetes	60
Varicocele	21
Positive Wassermanns	40
Tabes dorsalis	3
Miscellaneous skin diseases	12
Hydrocele	2

Another tabulation of 78,691 examinations showed that it was only necessary permanently to remove 122 men from service, an average of less than two men out of a thousand. Of the remainder, 265 were temporarily placed on sick leave until their conditions sufficiently improved for them to resume their duties. Of course this does not mean that of the 78,304 who were found fit for service all were free from every form of disease or infirmity; their conditions were amenable to treatment or correction. In the entire group of 78,691, a total of 1,684 were found to have herniae, and could be restored to physical fitness by operative means.

Three opportunities are afforded the Surgical Departments of our railroads for the proper study of mankind with reference to his physical standpoint:

1. Examination of the applicant for employment;
2. Physical re-examination,—whether periodic, special or for promotion;
3. When an injured employee reports for treatment.

Examinations made of applicants for employment and physical re-examinations are conducted along established lines so that at this time only mention of these is needed. However, the examination of an injured person, when reporting for treatment, is of exceeding importance, and it is all too frequently neglected, consideration being given only to the injury itself and the anatomical part affected thereby. A most wonderful opportunity for the upbuilding of man power efficency is thus being seriously overlooked, possibly lost. It is not meant that all injured persons should be subjected to the same class of routine physical examination required of applicants for employment or of those being considered for promotion. Such an examination would in many instances work a hardship upon the patient and require a great deal of unnecessary labor upon the part of the attending surgeon. However, the surgeon should be so trained in the close observation of mankind that even a casual inspection as the patient enters, or as the wound is being dressed, should reveal to him some idea of the patient's general physical status.

To him, the gait of an injured employee may indicate a lack of coordination, an incipient tabes dorsalis, arthritis, hip joint disease, flat foot, or some previous injury. This observation has required but a single glance upon the part of the surgeon to whom he is reporting for treatment, and yet may be of an inestimable value to the man himself in leading to a further investigation which may result in the proper handling and correction of his physical defect before it has advanced to such a stage as to render him unfit for service. At the same time a valuable employee may be saved to continue his service for the company. It has cost many dollars to make the employee efficient for the valued and responsible service he is rendering.

In many instances a glance at the pupils will disclose much valuable information and may be made so easily while examining a wound or applying a dressing. Any deviation from normal, such as irregularity, contracted or abnormally dilated pupils, and pupils irresponsive to light, may possibly foretell an incipient central nervous disturbance before it has advanced too far to permit of rehabilitation of the employee.

The presence of a skin rash or enlargement of lymph nodes may be readily detected while rendering treatment to an injury and, as above, be the means of salvaging the employee both for himself and the company. We could dwell upon many other conditions which might readily be detected by the surgeon in the course of his treatment of even the most simple injuries, while they are still in a remedial state, but time does not permit. The matter is merely brought to your attention with a view of showing to what a great extent a moment's observation may influence the man power of our railroads to a higher standard.

While care and treatment of injured persons is a paramount duty of the Surgical Department, other responsibilities, equally as important, are to permit employment of only those found to fully comply with the accepted physical standards, while maintaining the efficiency of employees by early detection of physical defects that arise while they may be amenable to arrest or correction.

During the 16 years of its existence the Surgical Section of the Association of American Railroads has accomplished much towards the upbuilding of the physical manpower of our railroads. Much remains for future accomplishment. Rehabilitation is most highly recommended, but the early detection of incipient maladies, while still in a remedial or corrective state, is of far greater importance to both the employee and the company. Every railroad Chief Surgeon, as well as every local surgeon or consultant on his staff, should ever bear in mind that as a physician he is a student of mankind—and "The Proper Study of Mankind is Man."

Silicosis Committees

SECRETARY of Labor Frances Perkins on May 2, 1936,* announced the appointment of four committees in the cooperative campaign to lessen the ravages of silicosis to which 500,000

* U. S. Dept. of Labor Release, May 3, 1936.

workers in mines, quarries, foundries, glass works and other industries where silica dust may be inhaled are exposed in some degree. She recently held a national conference at Washington D. C., to lay the groundwork for the first concerted drive against the disease which has taken a heavy toll among wage earners. Representatives of employers, workers, insurance companies, government, technical societies, engineers and physicians agreed to cooperate with the Department of Labor in a campaign to end silicosis.

"Silicosis, for which we know no cure, should be prevented," Secretary Perkins said. "The fact that it has been prevented in certain industries where there is exposure is sufficient grounds for making us believe that it can be successfully combated in practically all industries, and that every effort should be made to study the particular needs and problems of those industries so as to devise ways suitable for the control of the disease.

"The technique of silicosis prevention lies in keeping the dust from getting into the air which workers breathe. This can be done by different types of ventilation—not necessarily general ventilation—but specialized control and collection of the dust at the point of origin so that it does not escape into the workroom. The use of wetting down processes is also often helpful. The keeping of rooms clean, the cleaning of walls, floors and machinery is also of assistance. The wearing of positive masks is a possible method of control when nothing else is available, but this is not practical in most places and under most circumstances. It is difficult for men to do an eight-hour day wearing such a mask, but for certain short-time exposures it may be appropriate.

"Silicosis is caused by breathing very small particles of dust containing silica. The particles which are too small to be seen in the form of dust are the ones which are the most dangerous since, because of their minute size, they reach the small air cells of the lungs, penetrate the lining membranes and cause irritation. This, in turn, causes the replacement of healthy tissue by fibrous or scar tissue.

"The concentration of the dust is another test of the degree of the hazard; also, the length of time a worker has been exposed. A short exposure may not create any particular hazard and may not cause any after effects in the lung tissue. The degree of concentration of the dust and the length of exposure are extremely important factors.

"The symptoms are not very well known and are extremely difficult for the layman to recognize, also difficult for the physician to recognize; but in general one gets the picture—a general malaise, shortness of breath, early fatigue, sometimes with some slight visible symptoms, but usually not. The actual recognition and diagnosis of silicosis can scarcely be made without an x-ray examination. The symptoms of tuberculosis are often confused with the symptoms of silicosis, and, in fact, silicosis and tuberculosis may be present in the same individual and may be related to each other, thus increasing the danger to the individual.

"Many personal damage suits have been brought by workers who have acquired silicosis in the course of their employment, and are not covered by the workmen's compensation laws. These suits have proved costly and the attention of industrial and legal groups in every State has been riveted upon silicosis and how to deal with it. An extremely expensive economic situation ensues if everyone who acquires silicosis can bring a damage suit. There has been, therefore, considerable canvassing of the laws and of methods by which this disease can practically be brought under the workmen's compensation laws."

The following committees were announced:

Committee on the Prevention of Silicosis through Medical Control: Chairman—Surgeon R. R. Sayers, U. S. Public Health Service, Washington, D.C.;

Dr. J. Norman White, Glen Alden Coal Co., Scranton, Penna.;

Dr. C. H. Watson, President, National Safety Council, 195 Broadway, New York City;

Dr. Beverly L. Vosburgh, Medical Director, National Electrical Manufacturers Association, General Electric Co., Schenectady, N. Y.;

Dr. Leroy U. Gardner, Director, Saranac Laboratory for the Study of Tuberculosis, Saranac Lake, N. Y.;

Wesley M. Graff, Manager, Conservation Dept., National Bureau of Casualty and Surety Underwriters, New York City;

Thomas Kennedy, Secretary-Treasurer, United Mine Workers of America, Washington, D. C.;

Dr. A. J. Lanza, American Public Health Association, New York City;

Dr. William S. McCann, Professor of Medicine, University of Rochester, Rochester, N. Y.;

Dr. Eugene P. Pendergrass, University of Pennsylvania Medical School, Philadelphia, Penna.

Committee on the Prevention of Silicosis through Engineering Control: Chairman — Warren A. Cook, State Department of Health, Hartford, Conn.

Committee on Economic, Legal, and Insurance Phases of the Silicosis Problem: Chairman—V. P. Ahearn, National Sand and Gravel Association, Washington, D. C.

Committee on Regulatory and Administrative Phases of the Silicosis Problem: Chairman — L. Metcalfe Walling, Labor Commissioner, Providence, R. I.

Michigan Association

of Industrial Physicians and Surgeons

THE Spring Meeting of the Michigan Association of Industrial Physicians and Surgeons, held at Hotel Hayes, Jackson, Mich., on May 6, 1936, had the following interesting program:

Morning Session:

10:00—Registration.

10:15—Call to Order by the President, Dr. Henry J. Pyle, of Grand Rapids.

10:20—Greeting, by Dr. Charles R. Dengler, President of the Jackson County Medical Society.

10:30—"Industrial Eye Cases in Private Practice," by Dr. W. E. McGarvey, of Jackson.

11:00—"Burns," by Dr. C. N. Weller, Associate Surgeon, Children's Hospital, Detroit, (movie and exhibits).

12:00 noon—Lunch.

Afternoon Session:

1:30—"Protective Legislation for the Doctor," by J. Adrian Rosenburg, Rosenburg & Painter, Attorneys, of Jackson.

2:00—"Common Injuries of the Chest," by EDGAR W. DAVIS, Department of Chest Surgery, University Hospital, Ann Arbor, Mich. (illustrated with slides).

2:30—"Industry Turns to the Physician," DR. CAREY P. MCCORD, Director, Health Conservancy Laboratories, Cincinnati, (slides, gross specimens, autopsy material and special measuring instruments).

3:30—"Fractures of the Neck of the Femur, Acute and Ununited; Methods of Treatment for the Acute Fractures and Various Types of Treatment Available for the Ununited Fractures," DR. CARL E. BADGLEY Professor of Orthopedic Surgery, University of Michigan Medical School, Ann Arbor.

4:30—Business Meeting.

5:00—"Vascular Dilatation and Cerebral Stimulation," general discussion.

6:30—Annual Banquet.

8:00—"Clinical Aspects of Silicosis," by DR. ROSS K. CHILDERHOSE, of Allenwood, Penna., (slides and exhibit).

DR. HORACE W. PORTER summarizes the program as follows:

"It was the aim of the Program Committee to get away from the usual symposium on fractures as much as possible, and deal more with the medical side of our specialty of industrial medicine and surgery.

"The address of Dr. McCord was of unusual interest; the various occupational diseases had never been discussed so completely before at any meeting of this organization. Dr. McCord had just returned from Yucatan where he was sent to investigate an occupational disease which suddenly became prevalent among the natives who gather chicle for the chewing gum manufacturers. The disease consisted of an necrosis of the left ear and chin, with the right side of the face uninvolved.

"In addition to discussing occupational diseases in general, Dr. McCord demonstrated, by autopsy of three guinea pigs, one of which was normal, the results of injecting dust containing silica into the peritoneal cavity of these animals.

"Dr. McCord also demonstrated various instruments for the proper and accurate measuring of dust and carbon monoxide.

"The movie on 'Burns' was a clinical masterpiece; the result of considerable work on the part of Dr. Grover Penberthy and his Assistant, Dr. C. N. Weller, of the Children's Hospital, Detroit.

"Another outstanding feature of the day's program was the evening address by Dr. Childerhose, who is associated with Devitt's Camp for Tuberculosis at Allenwood, Penna.

"Situated as he is in the anthracite district, Dr. Childerhose has made the study of silicosis a hobby, and is well able to discuss the subject authoritatively.

"At the business meeting the following officers were elected for 1936-1937:

President—A. H. WHITTAKER, M.D., F.A.C.S., Detroit;

Vice-President — LEON SEVEY, M.D., Grand Rapids:

Secretary-Treasurer — DON F. KUDNER, M.D., F.A.C.S., Jackson;

Directors — L. H. CHILDS, M.D., Flint; CARL E. BADGELY, M.D., F.A.C.S., Ann Arbor; and HENRY J. PYLE, M.D., Grand Rapids."

Clinical Aspects of Silicosis

By ROSS K. CHILDERHOSE, M.D.,
Allenwood, Penna.

SILICOSIS is essentially an industrial disease and as such it has a vital interest for us.* Within the past decade especially, the interest in this particular industrial hazard has become so widespread, and the knowledge of the disease so increased, that it has become necessary for us as physicians to have a thorough understanding of the condition. Text books of 10 years ago contain little or no information on the subject, and we must concede that most of our knowledge is but recently acquired. Not only has interest become widespread amongst the medical profession, but legislators also, aided by representatives of labor, are enacting or propose to enact laws of compensation for the disability caused by this disease.

Considerable confusion exists regarding the various names that have been applied to lung destruction caused by dust. For example, the term pneumonoconiosis is the one usually applied to dust diseases in general, and because of this, is the preferable term because most cases are not due to one particular dust alone, but are a mixture of two or more dusts. For instance, the anthracite miner of Pennsylvania is subjected to two dusts, i.e., silica from the rock and coal dust. Thus, he has pneumonoconiosis rather than silicosis. The term anthracosis applies to the pigmentation of the lung caused by the carbon. Siderosis is considered as the damage to the lung by the inhalation of iron dust, but I doubt whether any actual damage to the pulmonary tissues is done. As we shall see, the actual destruction is caused by silica, and the term silicosis is now generally applied for all these conditions although, properly speaking, pneumonoconiosis is correct.

Dusts are classified into two groups, i.e., organic and inorganic. We find the first type of dust in many industries, more especially in the textile trades. Carpet and rug weaving factories are noted for their heavy dusts. Tobacco factories also have some degree of dust of this type. These dusts may cause harm to the workers by: (1) carrying inorganic dust particles along the lung, (2) by acting as a vehicle for the entrance of bacteria to the lung and thus causing an inflammatory reaction, or (3) by setting up a protein hypersensitiveness in the body to this particular dust. This latter condition appears in the form of bronchitis, rhinitis, and headache. In the textile industry it is known as "Shoddy Fever," and generally affects the new worker only. While these various disturbances by organic dusts may be serious or trivial, yet at no time do they cause a definite pulmonary tissue destruction, and for our discussion may be dismissed.

We must, therefore, look to the inorganic dusts as the cause of pneumonoconiosis. Any inorganic dust to do this must contain silica, either alone or in combination. It is amazing the number of industries in which silica may be the main constituent of the dust arising in the process of work. May I mention some of them?

Nearly all forms of mining render a silicosis

* Presented at the Spring Meeting of the Michigan Association of Industrial Physicians and Surgeons, Jackson, Mich., May 6, 1936.

hazard to the workmen, such as gold, silver, lead, zinc, copper, iron and anthracite. There is a high degree of hazard in the quarrying and dressing of granite, sandstone and flint. In iron foundries, particularly in the preparation of moulds for casting and the shaking out of these casts, we find a high silica content in the dust. Sand blasting, pottery manufacture, glass making, sand rock drilling for excavating work, all contribute a silicosis hazard at some stage in the work. I have only to remind you that silica is the chief ingredient in most of our abrasives, and this brings to mind scouring and polishing soaps and powders, sandpaper, sandstone and whetstones, sand blasting, and even some forms of tooth pastes and powder contain silica in a very finely ground state. In recent years the asbestos industry has been included, but this will be discussed later.

In order to have a clear understanding of the disease, we should remember several factors upon which its development depends. The *first* concerns the *size* of the dust particle inhaled. To be effective in its destructive action, all dust particles containing silica must be less than 10 u. in diameter, and the vast majority are certainly under 4 u. This means that the dust which is harmful is invisible. Particles larger than 10 u. cannot be phagocyted and are therefore carried off in the bronchial secretions. The *second factor* is the *density or concentration of dust.* Most authorities report this in the number of dust particles less than 10 u. in the cubic foot. Usually the number runs in the hundreds of thousands or millions depending on the clarity of the atmosphere. The standards of safety set up by various official bodies consider that a concentration of dust less than 10 million particles per cubic foot in which the free silica content is 35% or less to be the maximum limits of safety. Later, I shall discuss several industries and give the comparative dust concentrations that may be found when no prophylactic equipment is used. A *third factor* that is equally important in the development of the disease is the *length of time* to which the workman has been exposed. The duration of time necessary to produce silicosis is naturally affected by the other factors already mentioned, and will therefore vary greatly depending on the industry. Approximate time limits will also be mentioned later for some of the large industries.

In some industries the silica dust is contaminated by the presence of other inorganic dusts which seems to have either a stimulating or a retarding effect on the corrosive action of silica on the pulmonary tissues. Typical of these is that of coal dust which has apparently the effect of retarding silica, and that of alkaline soap in the abrasive soap industry where silicosis frequently assumes the acute form. Thus the problem of silicosis is different in different industries. The individual resistance of the laborer must also be taken into account. Many times I have been puzzled by the apparently small degree of fibrosis in a case where I would normally expect an advanced stage. These occasional cases have been explained by an extraordinary ability on the part of nature to excrete the silica before it can be ingested by the phagocytes and carried into the pulmonary tissues.

The action of silica on the pulmonary tissue is that of a foreign body having a corrosive action. The sequence of changes that occur in the lung following the inhalation of silica dust is readily understood by realizing that silica essentially causes an over-production of fibrous tissue and this in turn causes an entire derangement of the lymphatic drainage of the lung. Silicosis is therefore a disease or disorder of the lymphatic system of the lung. The pulmonary lymphatic drainage is slightly different from the venous drainage. Roughly speaking, we may say that the inner ¾ of the lung drainage is toward the hilum through the peri-vascular and peri-bronchial lymphatics, while the outer ¼ is drained through the subpleural cistern which in turn empties into the larger lymphatics along the inter lobar septa and from thence to the hilum. We shall see the importance of this in a few moments. At the bifurcation of each blood vessel lies a minute patch of lymphoid tissue through which pass these peri-vascular and peri-bronchial lymphtics. These lymphoid deposits act as an important filter to the inward passage of the dust particle.

Pathology of Silicosis

WHEN the dust particle reaches the alveolus it is phagocytosed by large mono-nuclear cells of endothelial origin, which for want of a better name have been called "Dust Cells". These cells are able at first to transport the particle to the neighboring tracheo-bronchial lymph nodes where their further progress is arrested, and the first destructive effect of the dust is noted. The present conception of its action is that silica is acted upon by the alkaline body fluids and slowly dissolves to form a complex colloidal silica hydroxide, which in turn has a highly corrosive action on the nearby cells. Thus we have a minute area of necrosis surrounding the dust particle. Because the conversion of the silica into the hydroxide is very slow we have, for practical purposes, a continuous irritant, and this explains why the simple removal of the worker from the dust exposure does not prevent a continued advance of the disease in the formation of scar tissue. This irritating and corrosive action of silica stimulates the formation of scar tissue in its neighborhood to an over abundance. Naturally, this distribution of scar tissue will depend on the lymphatic drainage. Thus, early in the disease we will see an intensification of the trunk markings and a nodular appearance on the x-ray film from fibrous tissue formation along these vascular channels. These small areas of fibrosis will be seen particularly in those minute areas of lymphoid tissue. With continued dusting these nodules become larger and give a "snow-storm" effect on the x-ray film. Should, however, the exposure to silica be so intense or carried out for a long time the lymphatic drainage becomes so disorganized that dust accumulates in the interstitial tissue and massive areas of fibrosis are formed. That portion of the lymphatic drainage that runs peripherally also carries dust particles, and in the course of time a pleuritis results and dense pleural adhesions are formed. The density of these adhesions is often astounding, and at autopsy they make the removal of the lung very difficult. These adhesions, especially at the diaphragm, interfere with respiration and a characteristic finding of the third stage is the marked irregularity and fixity of the diaphragm. With the continued formation of scar tissue, a marked degree of emphysema develops and, especially

along the mediastinal margins, the alveoli enlarges so greatly that emphysematous blebs are often found at autopsy. In the later stage of the disease there is a partial obliteration of the vascular bed and increased pressure results on the right heart. The whole picture is one of excessive proliferation of fibrous tissue with nature making valiant efforts to compensate by emphysema. Naturally the vital lung capacity is lowered and the extra burden put on the heart, bringing the final picture to one of cardiac decompensation.

Clinically, the disease is divided into three stages, but this classification depends more on the x-ray picture than on the actual clinical findings. Several classifications have been advanced, some of which are very complicated. None of them is entirely satisfactory but the one in general use is as follows.

STAGE 1: Physical signs and clinical symptoms are absent, but the x-ray shows a slight increase in the hilum shadows and perhaps there is a slight restriction of the right half of the diaphragm under fluoroscopic examination. Some claim that a slight haze in the mid-zone of the right lung is indicative, but I doubt whether this is entirely reliable. The x-ray diagnosis at this stage is most difficult.

STAGE 2: Physical signs and clinical symptoms are usually absent although there may be a slight bronchitis and the vital lung capacity is moderately lowered. The x-ray appearance is, however, quite characteristic—nodular shadows distributed equally on both sides in the inner ⅔ of each lung field.

STAGE 3: Physical signs are those of emphysema and moderate bronchitis. There may be a low grade fever but the most prominent sign is that of dyspnea on mild exertion, and some cyanosis. The x-ray picture discloses large patches of fibrous tissue in both lungs, distortion of the diaphragm by numerous pleural adhesions and areas of emphysema, particularly in the apex and at the base.

In acute silicosis, the first and second stages are not often seen because the process is so rapid that large masses of fibrous tissue form directly.

Complications

THE only complication of importance is *pulmonary tuberculosis.* It is a recognized fact that if there has been a pre-existing latent tuberculous lesion the inhalation of silica dust will undoubtedly re-activate it. If, however, the silicosis has been well established, then the secondary infection of tuberculosis will be somewhat limited and tends to be chronic. There is a certain similarity between the two diseases in that both have a predilection for the lymphatic system. If the lymphatics are obliterated or badly disrupted by areas of fibrous tissue, then the tuberculous lesion tends to be hemmed in, so to speak, and we have a fibroid type of tuberculosis. Just to emphasize the importance of this complication let me quote the figures of the Massachusetts Special Industrial Commission. Their findings among industrial workers were that the tuberculosis death rate among granite workers was 33%, and among tool sharpeners was 15%, while the proportionate mortality of males over 20 in the general population was only 7%. These figures apply, of course, to cases of pure silicosis, but sometimes the tuberculosis is modified by a contaminating dust. In the anthracite industry tuberculosis assumes a very chronic form with very few symptoms. This has been attributed to the "protective" action of the coal dust, but the exact explanation is still forthcoming. Where an alkaline dust is found in combination with the silica, as in the abrasive soap industry, not only is the action of silica enhanced, but also, the susceptibility of the worker to tuberculosis is increased.

Diagnosis

THE diagnosis of silicosis, like all other diseases, depends upon a well taken history. It is not sufficient merely to inquire whether the man was working in a dusty occupation. One should know the particular type of work, how long he has been at it, what precautions the company has taken to prevent dust, and what his former occupations have been. Frequently, with a well taken history, a diagnosis can be made with a fair degree of accuracy, and the diagnosis can then be clinched by an x-ray. The roentgenological picture is no doubt familiar to you. A combination of the history and the film is in most cases, sufficient for the diagnosis. Unfortunately, the physical examination of the chest is not of much value. The fibrosis, even when in large masses, gives very few signs because of the overlying areas of emphysema. It is this emphysema that acts as an effectual blanket, and hides the underlying pathology.

About the only problem in differential diagnosis is that of tuberculosis, and usually it is a question of whether tuberculosis is a complication or not. Generally, one can say that the distributions of the shadows on the film are those of silicosis because they have an equal and bilateral distribution, and are found chiefly in the mid-zone of the lung. In distinction, the shadows of tuberculosis have a predilection for the apex and are often unequally distributed. The presence of a cavity is a definite sign of tuberculosis, since we never get excavation in a pure case of silicosis. Just a word of caution in the interpretation of cavities in advanced stages of silicosis:—I have often been misled by the presence of areas of emphysema which are surrounded by patches of fibrosis. The appearance is most deceptive, and frequently the only means of definitely determining the presence of the suspected cavity is by autopsy. However, nearly all patients with cavity formation will show tubercle bacilli in the sputum. In all suspected cases of tuberculosis it is necessary to examine the sputum thoroughly. Just to rely on one or two negative sputum examinations is to have a false sense of security. I have seen many cases of silicosis with cough and expectoration, no fever, and normal weight and working, who are open cases of tuberculosis, and who were, therefore, continually infecting their families. It has been my practice to require at least 10 negative sputum examinations and two 24-hour collection specimens which were examined either by concentration methods or by culture or guinea pig inoculation. Every case of silicosis should be considered as a probable tuberculosis patient until proven otherwise, and even then he is a candidate for an acid fast infection.

Individual Industries

THE hazard of silicosis naturally varies in degree among the different industries in which silica is used. Some industries have more dust than others. Probably the greatest concentration

of dust is to be found in hard coal mining where miners and miners helpers may be exposed to as high as 232 million particles per cubic foot. Fortunately, this dust has only 1½% of silica in it. However, the rock drillers in the anthracite mines get an average exposure of 82 million particles per cubic foot, and the silica percentage is up to 31. This is explained by the fact that the rock in that region contains about 31% free silica. Usually, it takes about 20 years for the regular miner to develop a second or third stage silicosis, but the rock driller, on the other hand, will show a third stage in as short a time as three years. For some reason or other silicosis is not seen to nearly the same extent among the soft coal workers as we see it in the anthracite region. There are probably 100,000 miners in the anthracite area, and you can understand that silicosis is quite a problem with us.

The asbestos industry has come in for much attention in recent years. The action of asbestos on the lungs is similar to that of silica and in composition asbestos is a magnesium aluminum silicate, with traces of iron. The destructive effect is not as serious as pure silica, but it is supposed that asbestos undergoes changes in the lung quite like those of silica, only slower and that asbestosis, as it is called, is a true silicosis. The most dusty asbestos occupations are to be found in the factories, especially where the mineral is broken up and finally woven into the numerous materials with which we are familiar. The disease rarely advances to the third stage. The one unique feature of its pathology is the presence of the so-called "asbestos bodies". These are highly refractive bodies about 20 u. to 100 u. long. They are yellowish-brown in color and do not take any stain. In shape the bodies may be clubbed, and they give a Prussian Blue reaction for iron. In fact, it is believed that they are partly caused by the iron that is found with the asbestos mineral. The finding of these bodies either in the sputum or at autopsy, confirms the diagnosis of asbestosis. There is the same frequency of tuberculosis in asbestosis as in silicosis.

One of the great uses of silica is as an abrasive. Because of its hardness, it lends itself particularly well for this purpose. One of the chief offenders is the sandstone wheel, and under its use there is formed a constant stream of silica dust. Metal dust is also formed. but it does no damage. Tool grinders may be subjected to a dust concentration of as high as 20-30 million particles per cubic foot. Some grinders have shown a third stage silicosis after five to eight years' occupation. The use of water on the stone in tool sharpening is of very little value. In a British study of 500 grinders who had worked at this occupation for 21 years there were 73% who had silicosis. It is now advised that the carborundum be substituted for the sandstone wheel because it is not nearly so dangerous, this, because it does not wear away so quickly and has very much less free silica.

Silica is also used in the form of sand blasting. Needless to say, this exposes the worker to a real silicosis hazard. In the iron foundry, the use of sand in casting causes quite a high concentration of silica in the atmosphere, particularly in the shaking out of the casting and cleaning the casting. In Massachusetts, a study of these conditions revealed a dust count as high as 200 million for the sand chippers and 84 for the sand slingers. In glass manufacture, the hazard of silicosis may be high and also in certain parts of the pottery works. Each industry is a study in itself.

The more one studies the subject of silicosis the more one is amazed at the innumerable uses that modern science has developed for this seemingly inert substance. All the way from astronomical telescopes to tombstones do we find silica.

Treatment

I THINK we all realize the seriousness of silicosis, and naturally our problem is how to prevent it. This can be done in one way only. That is to remove the dust at its source. Vacuum dust removal equipment is the only way to insure against this danger. Standards of safety require that dust counts be kept under 10 million per cubic foot. The use of face masks, except where a definite supply of fresh air is given continually, is of no use. Those small face masks that cover the nose and mouth and contain a wet sponge are dangerous because they do not prevent the dust from entering the lung, and give a false sense of security.

Once the disease has gained a foothold, the man should change his occupation, but even this will not stop the gradual formation of fibrosis in the future. In the advanced stage, the patient should be put to bed, and if possible, given sanatorium care. In this way the cardiac reserve can be improved, and the patient made more comfortable. The seriousness of silicosis as an industrial hazard requires our careful consideration and study just as much as any other major problem.

Traumatic Derangements About the Ankle Joint

By M. T. Koven, M.D., F.A.C.S.,
and
H. E. Beller, M.D.
Brooklyn, N. Y.

MANY traumatic mechanisms about the ankle joint are incompletely understood and often are inadequately treated. We shall attempt to classify the most important derangements while integrating where possible the manner of their causation and the lesions produced and methods of treatment.

The three chief factors which determine the type of injury in and about the ankle joint are the force of the impact, the obstacle, and the position of the foot when striking the obstacle. Thus, running or jumping proportionately increases the force, while the relation of the position of the foot impacting against an obstacle to a large measure determines whether the foot inverts or everts.

In the discussion to follow, one notes that the astragalus appears to play the most important role in the anatomic consideration. From its position it is the pivoting bone buttressed between the ankle joint and the foot. Hence, it is essential to review some features of the astragalus. Superiorly, its articulating surface narrows from the anterior to the posterior portion and articulates with the tibia. In complete dorsiflexion the wider sides are wedged firmly against both malleoli. In plantar flexion this mortice is insecure because of the space between its posterior lateral walls and the malleoli.

---

* Read before the Association of Traumatic Surgeons, New York City.

The discussion will embrace simple sprains of the ankle joint, sprain fractures, fractures of the lower fibula with little or no displacement, derangements of the tibio-fibular joint with and without fractures, fractures of the lower tibia and subluxations of the subastragaloid joint.

Simple Sprains

IN THE sprain mechanism, the foot is usually square on the ground or in dorsiflexion in which position, as was stated, the astragalus is firmly wedged. This usually occurs when the propelled foot meets an unexpected obstacle, such as a rock or a defect on the ground, and the affected extremity is immediately halted. A twisting occurs, with the stretch usually expended on the external lateral ligament.

The symptoms and findings are pain, quick swelling on the outer side of the ankle, and tenderness at or just below the external malleolus, At this point, the force has expended itself on the soft structures.

In treatment, relief of pain is the guiding factor. In superficial trauma, rest for 24 hours and cold dressings. If after that time, the patient can walk without difficulty, no support is necessary. Pain without support means that adequate fixation is necessary which is best obtained by a firm basket weave strapping. The foot is strapped at a right angle or in the neutral position. The indication for fixation in this position is that repair of the injury to the external lateral ligament in eversion frequently results in adhesions in the lateral retinacular space traversed by the peronei tendons. Hence, the eversion position frequently results in contracture which may lead to the production of a traumatic flat foot. Should pain persist despite adequate adhesion fixation, then apply either a light plaster cast with a walking iron or off-weight bearing until repair has taken place.

Sprain Fracture

THE position of the foot and the obstacle may be as that found in simple sprains, but the impact is greater. With advancing age bones become more brittle and may fracture readily. Inversion is more frequent, so the result is an evulsion fracture of the tip of the external malleolus rather than a tear of the ligament attached thereto. The astragalus now free from its external attachment pushes against the internal malleolus and may break it, particularly if the force continues. The symptoms and findings are more severe than those of a simple sprain, and lead one to seek roentgenological aid.

The treatment is the application of a plaster cast with an incorporated walking iron. The foot is fixed at a right angle to the leg with the heel in a neutral position in such a way that the fibular fragment is not separated from its previous alliance. This position is usually maintained for about four weeks. The after treatment is physiotherapy as necessary, and repeated adhesive strappings are applied. If pain persists, a cast is maintained longer without fear of ankylosis, as the constant thumping on the walking iron (Fig. 1) maintains freedom of joint motion.

Inferior or Tibio-Fibular Articulation

THESE occur more frequently than is recognized and require some anatomical orientation. Such cases are usually designated as chronic sprained ankles. If inadequately treated during the acute stage, pain frequently is a persistent factor, aggravated by walking, especially on uneven surfaces. In others, there is a sense of stiffness of the ankle.

At the ankle, the fibula fits into a longitudinal groove on the lateral side of the tibia. Union is effected by a dense felt-like ligament which is the continuation below of the interosseous membrane reenforced by the anterior and posterior tibio-fibular ligaments. With advancing age, the tensile power and elasticity of these ligamentous structures are lessened, so that separation and bony injury are more common. The usual mechanism in this lesion is that of striking the medial or inner surface of the forefoot in a plantar flexed position while running or jumping. The blow is transmitted in an upward and outward direction through the metatarsals and the mid-tarsal bones, as the small bones of the foot are firmly wedged. Any mechanism whereby the impact is on the inner aspect of the foot, may expend its force so as to produce a tearing of the tibio-fibular ligament.

Fig. 1. Right angle iron incorporated into hardened cast, fixed by two rolls of plaster

It is interesting to note that an obliquity between the lower surface of the tibia and the articular surface of the astragalus persists from early life in an attitude whereby the upper outer ridge of the astragalus is at a higher level than the medial surface, due to the persistent trapezoid formation of the lower epiphysis of the tibia. Bohm[1] has concluded that this anatomic formation is the causative factor of the so-called congenital flat foot. The line of force expended from the medial aspect of the foot plus a rotary everting force will tend to wedge the astragalus between the tibia and fibula, tearing the tissues which bind these bones and producing separation of a varying degree.

Clinically, these cases manifest a widening of the ankle joint and separation of the malleoli. There is swelling of the anterior lateral aspect of the ankle joint. The point of greatest tenderness is also located anteriorly between the tibia and fibula. The range of ankle motion may or may not be limited.

The severity of this type of injury is not usually

1. BOHM, MAX: The Development of Juvenile Pes Valgus, Translated from the German by W. P. Blount, M.D., Milwaukee, Wis. *J. Bone & Joint Surg.*, Vol. XII, No. 2, April 1930.

appreciated and has frequently resulted in prolonged disability. It is difficult to note any pathology upon routine x-ray examination, but Haglund[2] has called attention to the correct method of roentgenological study in this condition. The anterior outer border of the tibia projects further laterally than does the posterior border. Hence, using the medial anterior tangential surface of the fibula and the outer posterior border of the tibia as

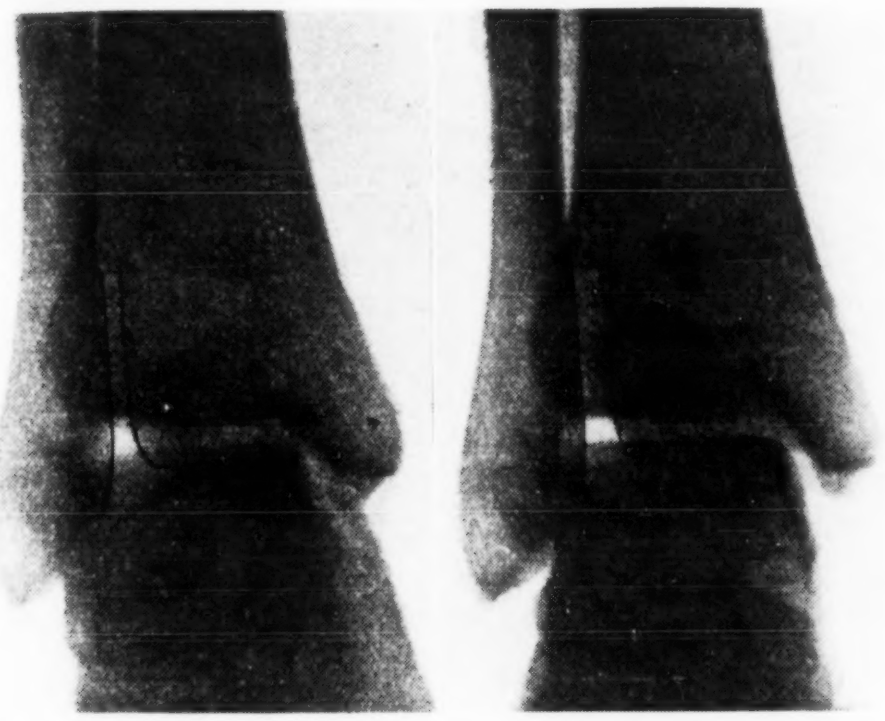
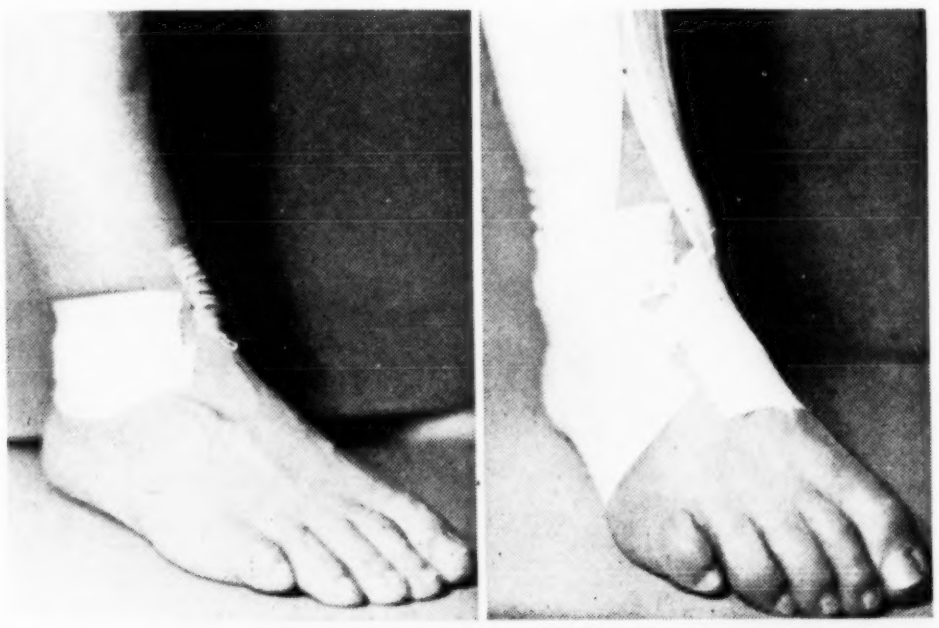


Fig. 2. Ink lines intensify tangential surfaces of tibia and fibula, after Haglund

guides, differences in spacing can be noted on comparative x-rays with exact technique. (Fig. 2.)

In treatment, as the astragalus is wedged in between the tibia and fibula, it is essential to disimpact this bone. This is accomplished by firmly grasping the heel and, with forceful jerky motion, drawing the foot downward and in inversion. Usually a click is heard on release of the disimpaction. When the foot is held in inversion and dorsiflexion, the swelling lessens. The tenderness previ-



Figs. 3 and 4

Fig. 3. Cross adhesive straps commence at tibia—curved to front of lower fibula

Fig. 4. Basket weave strapping over cross straps

ously noted also tends to disappear. Fixation is in an adhesive plaster in such a manner as to coaptate the malleoli. Several narrow cross strips are drawn across both malleoli, commencing from the tibia around the posterior aspect of the ankle and curved around below and across the lower end of the fibula. These strips are reinforced by a typical basket weave ankle strapping. (Figs. 3 and 4). It is advisable to reinforce the adhesive with a firm bandage. In individuals whose occupation requires immediate weight bearing, or in heavyweight patients, a firm molded cast is applied with a walking iron incorporated and is maintained for about three weeks.

Fracture of the Lower Fibula

THE mechanism is one of a force striking the medial aspect of the foot, continuing upward, backward and outward without injuring the tibiofibular ligament. As the force continues, external rotation of the foot occurs and the astragalus is pushed against the external malleolus. A torsion fracture results, in which the lower fibular fragment is spiraled from a broad base medially to its apex upwards and outwards. With the mechanism of external rotation there also occurs fibular flexion, and the tip of the internal malleolus is frequently fractured. When the standard positions of antero-posterior and lateral x-ray films are tak-

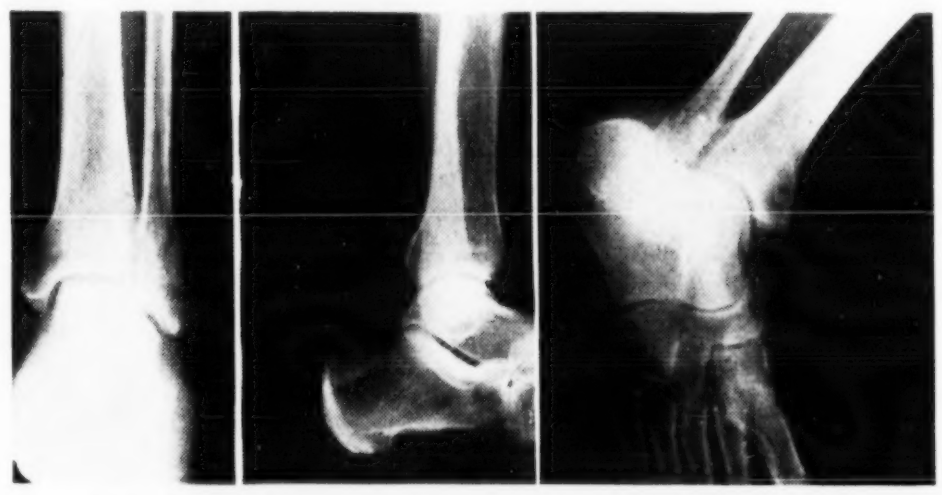


Fig. 5. Antero-posterior, lateral, oblique views

en, the fracture of the tip of the malleolus of the tibia is not usually seen, and frequently the line of fracture in the fibula is overlooked. Therefore, it is advisable in cases of suspected fracture to take an additional oblique view, which is done by placing the foot in an inverted plantar flexed position with the great toe touching the table and the fifth toe elevated. The x-ray cone is centered over the ankle. In this view, the ankle joint is separated, and the fracture of the tibia will be more frequently noted and the spiral fracture of the fibula is more prominent. (Fig. 5.)

The diagnosis is fairly evident by the swelling, marked local tenderness and the Roentgen findings. As the integrity of the ankle joint is not disturbed, the routine treatment of casting with the foot in inversion and dorsiflexion is sufficient.

The mechanism discussed in the two latter types is frequently combined, producing a tibio-fibular separation due to outward displacement of the astragalus, and then the continued exertion of the force in an upward and outward direction produces a fracture of the fibula as well as an evulsion fracture of the malleolus of the tibia. These cases show, in addition to the local swelling and tenderness, more deformity and a marked limitation of ankle joint motion, especially in dorsiflexion. These are the cases that conform nearest to the classical description of the Pott's fracture.

The term of Pott's fracture is erroneously used by most practitioners to designate all types of fractures about the ankle. The lesion described by Percival Pott in 1819 is a fracture of the fibula not

2. HAGLUND, P.: Studien Uber die Gabelsprengung, *in Fussgelenk Acta chir. Scandinav.*, 71:280.

higher than two to two and a quarter inches above the tip of the external malleolus with rupture of the internal lateral ligament accompanied by an outward dislocation of the foot. (Fig. 6.)

Reduction is advisable as soon as the diagnosis is made and confirmed by x-ray. Deep inhalation anaesthesia, or, if reduced within the first eight hours, local novocain infiltration is used. Disimpaction of the astragalus must first be obtained by the manipulation as previously discussed. The foot must be brought into marked inversion and dorsiflexion and so maintained until the cast hardens. To maintain the foot in this attitude, we have adopted as a routine to apply the cast with the patient lying in a prone position on his abdomen. In this position, the plantar surface of the foot is the most prominent part facing the operator. The foot is more correctly maintained in dorsiflexion and held in inversion. The knee is kept flexed while the thigh is supported against the table,

Fig. 6. Typical Pott's fracture of fibula about two inches above malleolus; lateral displacement of astragalus; fracture of malleolus of tibia

Fig. 7. View showing attitude of correcting and maintaining heel and sole before cast application

thus obviating the necessity for an assistant to hold the knee in flexion. (Fig. 7.) A cast is applied with padding to protect bony prominences. A circular felt pad about two inches wide is rolled below the knee (protection for the head of the fibula). A thin felt pad is placed down the crest of the tibia and continues across the ankle to the dorsal surface of the foot. A heavier felt pad encircles the back of the heel and both malleoli. A posterior moulded plaster splint is applied from the knee down the leg and continues over the plantar surface of the foot, extending beyond the toes. A plaster bandage encircles the leg from above the ankle to the knee. About six turns of plaster are rolled across the foot from the toes to the ankle. Before encasing the ankle, the operator can check up to note whether the foot is maintained in the

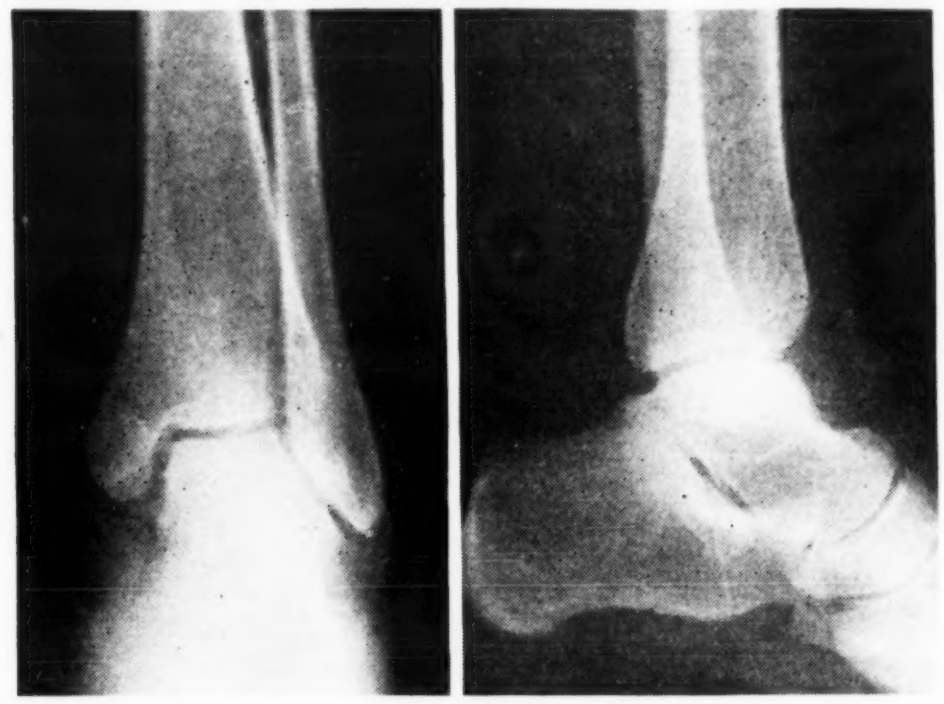


Fig. 8. Fracture of tibia; no displacement

desired position. Then apply a circular plaster bandage to fix the ankle. After this stage, the patient is turned on his back, additional plaster is rolled as is necessary, and the cast is properly trimmed.

If a good reduction is obtained, a walking iron is applied in about two days; weight bearing is allowed. The minimum time for fixation is between five and six weeks. Despite prolonged immobilization there is very little stiffness and swelling due to the circulatory and cellular massage which results from thumping on the walking iron. Strapping and a proper supportive shoe usually complete the treatment.

The Lower End of the Tibia

THE mechanism is such that the force strikes the outer side of the foot which results in an inversion of the foot. If the impact is not too severe, a tear of the external lateral ligament or a sprain fracture of the fibula results. With an increasing impact, particularly in falling from a height, the severity increases. So that after the external lateral ligament of the malleolus of the fibula has given way, the astragalus tilts inwards and produces a fracture of the tibial malleolus, (Fig. 8) or with a sharper tilting of the astragalus a perpendicular fracture through the medial aspect of the lower end of the tibia results. The displacement is usually not severe. Reduction is frequently possible without anaesthesia. If there is limitation in dorsiflexion or the fragments require proper moulding due to separation then an anesthetic is used. The foot is dorsiflexed to its full range with no attempt made at eversion or inversion. A light padded cast is applied with a walking iron incorporated. In about five weeks, the cast is removed and adequate after treatment is instituted.

Posterior Displacement of the Foot

THIS lesion occurs when the foot is plantar flexed in a neutral position, as in catching of

the heel of a shoe on a step and falling forward. The force is transmitted upward and backward via the astragalus which fractures the posterior lip of the tibia and wedges itself between the fractured parts. This posterior luxation of the astragalus may fracture both malleoli inasmuch as the broader anterior portion of the astragalus forces the bones apart in its backward trip. This upward mechanism may be associated with a rotary eversion and inversion force, producing a postero upward displacement of the astragalus which results in a fracture of the posterior lip of the tibia and various types of fractures of the malleoli of the tibia and fibula. (Fig. 9.)

The diagnosis is obvious from the marked deformity, the inability to dorsiflex the foot, and the bulging of the lower part of the leg at the anterior aspect of the ankle joint.

Such cases must be reduced immediately. However, despite proper early reduction and adequate after care, these are most disabling injuries and frequently result in traumatic arthritis.

Proper reduction requires anaesthesia and an accurate conception of the deformity. The astragalus is not only displaced upwards, but also is frequently wedged firmly between the broken surfaces. Manipulation directed toward producing dorsiflexion may not liberate the astragalus. This bone must be pulled downward and forward and maintained in its normally correct compartment. The best method of obtaining and maintaining such reduction can be found in the use of a Steinman nail. The nail is driven through the os calcis, and manual traction is applied through the nail in a downward direction in order to disimpact the astragalus. While the foot is drawn downward and forward, an assistant pushes the leg backward. If reduction is adequate and there is no lateral mobility of associated malleoli fractures, a cast is applied from the toes to the knee with

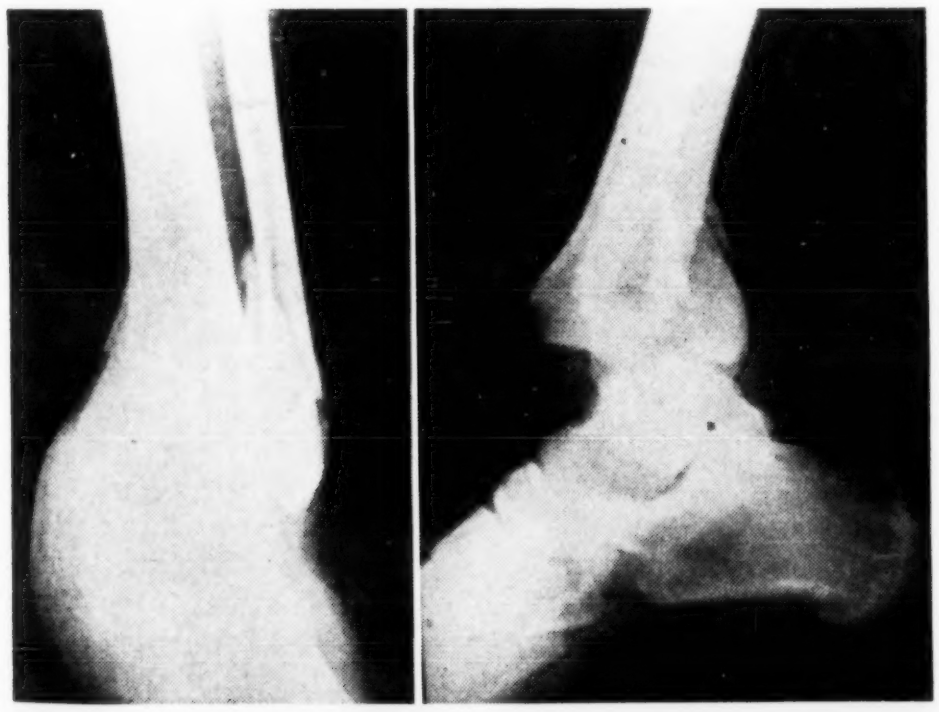


Fig. 9. Posterior displacement of astragalus. Fracture posterior malleolus of tibia

the foot in dorsiflexion and inversion. The Steinman nail is incorporated in the cast and maintained for about three weeks. (Fig. 10.) At that time the nail is removed and a new cast is applied with a walking iron incorporated. At times, despite adequate reduction, there is lateral joint instability due to the malleoli fractures. In these cases it has been found necessary to maintain the fragments in position by traction through the nail with a 15-lb. weight and compression pads placed across the malleoli. After three weeks there is enough fixation to remove the traction, and a well fitting cast is applied. If the malleoli cannot be maintained with compression, a short nail is driven through the fractured malleoli.

In this type of case, cast fixation is necessary for 12 weeks. Since the patient is usually allowed

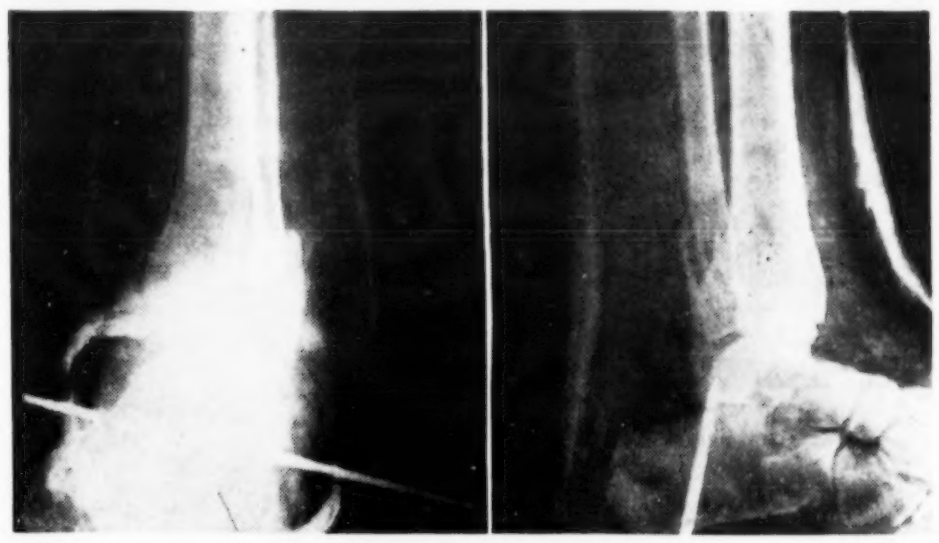


Fig. 10. Reduction of Fig. 9. Note Steinman nail in os calcis incorporated in cast

to walk about on the iron in the cast, the prolonged fixation does not result in much stiffness in the ankle.

Subluxations of the Subastragaloid Joint

SUBLUXATION of the subastragaloid joint is an uncommon injury, but one which often produces marked disability.

Careful examination reveals that the posterior portion of the foot is sunk, i.e., the malleoli are lower or nearer the heel than on the opposite side. There is tenderness below both malleoli and marked limitation of inversion and eversion. If careful x-ray technique is obtained, using the sound foot for comparison, lateral views will illustrate some characteristic findings. A narrowing between the superior surface of the calcaneus and the inferior

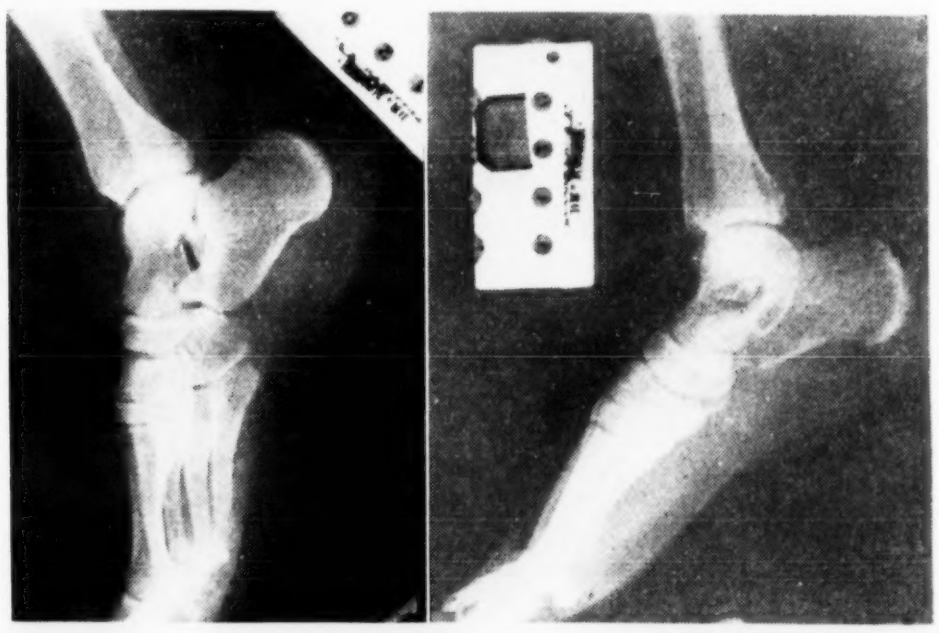


Fig. 11. Comparative views of both ankles. Note obliteration of subastragaloid joint and loss of "S" curve

surface of the astragalus is noted. Frequently this joint space is completely obliterated. (Fig. 11). Chopart's joint which is the articulating surface of the astragalus, scaphoid, and the calcaneus, and cuboid is a continuous line which forms a modified letter "S" in relation to the hind foot in the lateral view. This continuity of the "S" line is broken in subastragaloid subluxations.

The lesion is best treated by manipulation un-

der anaethesia until the full range of lateral motion is obtained. A light cast is then applied with the foot in dorsiflexion, the heel in full supination and the forefoot in compensatory pronation. This should be maintained for about three weeks, with a walking iron having been incorporated. At the end of that time, after care is administered consisting of physiotherapy and the wearing of a stiffened shank shoe or foot plate. The latter is absolutely essential in forestalling the possible eventuality of a traumatic weak foot.

Summary

THE common derangements of the ankle joint have been discussed and the mechanism of their production outlined. It has been pointed out that a clear understanding of the pathological physiology of these lesions is essential to intelligent treatment and good end results.

Medical-Engineering Control of Industrial Health Hazards

By T. LYLE HAZLETT, M.D.,
Medical Director,
Westinghouse Electric & Manufacturing Co.,
East Pittsburgh, Penna.

THE development, over the past few years, of an added interest in human relationships has led to a new trend of medicine in industry. This has been due in part to the even greater recognition of the solidarity of interests between employers and employees, more particularly in the larger companies, and in part to the increased frequency of common law suits for alleged negligence on the part of employers and to the inclusion of certain diseases in compensation acts in various states. During this depression period, also, industrial workers with decreased earnings have leaned upon employers to a greater extent for medical care. The result has been a great galaxy of diseases, some of which are definitely from an industrial source while others, notwithstanding they are common to the race, are being classified as "occupational." Industrial management is now showing an increased interest in alleged health hazards in industrial plants, and is seeking closer contact with the medical profession.

Until recently the physician in industry received too little recognition as a part of industrial management. With these changing conditions the usefulness of the physician is undoubtedly becoming more appreciated, with the result that there will be a constantly increasing demand for his services in a consulting capacity.

The following "ad" which appeared not long since in one of our leading newspapers may be said to reflect the present general attitude of employers:

INDUSTRIAL PHYSICIAN

Large manufacturing organization with headquarters in Middle West and factories throughout the country has opening for young clinician in industrial medicine; research in health maintenance; potential opportunity to assume responsibility for direction of comprehensive medical program. Successful candidate will be given opportunity for special training in industrial hygiene.

Many are of the opinion that this attitude may change, but there is no doubt that certain policies recently adopted with respect to the safeguarding of the health of industrial workers will be permanent.

How is the medical profession going to meet this situation? The passive attitude which physicians have shown in the past with reference to the formulation of medical policies in industry, has given non-medical groups a wide latitude in carrying out many controversial practices in the medical care of industrial workers. Unless the medical profession becomes interested and formulates some means of protecting the health of industrial workers the responsibility will undoubtedly be placed in the hands of lay groups, which has so often been the case in the past. Consequently, there has arisen considerable criticism both on the part of industrial management and the medical profession as to the extent to which industry may assume the care and safeguarding of the health of employees in whom a very considerable investment has been made.

THE lowest estimate of the cost for employing a new industrial worker is $100, while some estimates are as high as $500. This includes the time necessary for training, defective work during the training period, efficiency to be attained to bring the new worker to a point where he can contribute an equal share with his fellow workers. In many instances it takes considerable time to discover the ability of a new worker to perform work assigned, which often means he may not have the necessary qualifications for the job for which he was employed but he has shown sufficient ability and personal qualifications to warrant transferring him and training him for other work. Such procedure is of great advantage to the worker as well as to the employer.

Investment in this individual multiplied by the number of employees in any single industrial organization is large, and if ignored means thousands of dollars invested from which there is no return; hence employers recognize that any labor turnover demands close attention, and necessary policies to eliminate the causes must be instituted.

In the larger industrial organizations the Medical Department should assume responsibility for proper placement with respect to mental and physical qualifications, having attached to its staff the necessary engineering consultants. This medical-engineering staff should have at its disposal the necessary equipment for investigating any plant condition or process which might be suspected of being a health hazard. The equipment should include sampling devices and chemical materials for determining dusts, fumes, and gases which may be encountered in the particular industry.

In the smaller plants where such a staff could not be supported financially, close cooperation might be maintained between the physician to whom injured employees are referred for medical care and the engineering staff of the plant, the engineering staff of the compensation insurance carrier, and, if possible, larger plants having similar processes. In this manner medical-engineering control might function at all industrial plants regardless of size, thereby building up knowledge which would be invaluable both to employers and employees.

THE physician working in conjunction with the engineer who understands the various processes is in a better position to diagnose any disease which may be felt to have an industrial origin or to eliminate the industrial cause. This in turn may determine the proper and immediate medical treatment, and avoid possible errors of diagnoses due to a lack of knowledge of the exact nature of the occupation; as, for example, the confusion perhaps of carbon monoxide poisoning with a diabetic coma; chronic lead poisoning with a peptic ulcer; occupational dermatitis with dermatophytosis (fungus infection).

The engineer, in turn, with a *medical* contact will have a clearer understanding of what conditions may constitute a health hazard. In the designing of new equipment or in changing present methods of manufacture possible health hazards will be foreseen and eliminated before installation. This will result in a material saving in future cost of protective equipment, in increasing the efficiency of workers, and in eliminating future liabilities.

The engineer should study conditions which may be detrimental to health and by quantitative measurements determine the dosage of substances that workers receive. In conjunction with the findings of the physician safe practices may eventually be determined for any occupation. Among the means at the engineer's disposal for eliminating an occupational hazard may be mentioned:

1. Removal of source:
   (a) substitution of non-toxic materials;
   (b) complete isolation of process;
   (c) wetting dry, dusty materials.
2. Protective devices:
   (a) air conditioning;
   (b) respirators;
   (c) dermal coverings.

The investigations by the physician of industrial processes thought to have an injurious effect on the individual worker will require a careful periodic physical examination. In certain types of occupations it will necessitate additional studies, as blood, urine, sputa, feces, and roentgenological examinations.

The practice by industrial management of making periodic physical examinations of industrial workers has been somewhat controversial. Many physicians have felt that this procedure has been opposite to good medical practice, whereas in reality it fosters a closer relationship between physician and patient, for most physical defects found at the time of such an examination are in no way connected with the individual's occupation. The employee is urged to correct, by consulting his family physician, conditions found which later may or may not cause lack of earning capacity and economic insecurity, whereas if these conditions were not brought to his attention he would have had no thought of seeking medical advice. With this added knowledge of health problems the worker also feels an increased responsibility for the medical care of his family.

Thus there is established a still closer contact with the family physician.

The economic value of such examinations, not only to industry but also to the individual, cannot be estimated by any known standard of measurement. It can be appreciated only by one who over a period of years sees the number of individuals in a large group who, without medical supervision, would have become totally disabled and forced to cease all gainful employment.

The greatest example of such health supervision has been in the control of tuberculosis in industrial organizations that have had well defined health programs over a period of years. No other disease affects the economic security of the industrial worker to such an extent as tuberculosis.

From the large number of physicians who see industrial workers from a surgical standpoint certain contacts have already been established with employers so that it is only a step ahead for them to assume the responsibility of safeguarding all workers from a health standpoint.

And who is better qualified?

WHILE industrial hygiene must of necessity be considered a post-graduate course in our medical schools, nevertheless some conception of this problem should be given to undergraduates. Simply knowing the symptoms of a few common poisonings which may occur in industry will handicap the average medical graduate if practicing in an industrial community. This lack of training often results in hasty diagnosis and in the patient's occupation being regarded as the cause of the illness, if no other cause is easily discernible. All too frequently no effort is made to contact the employer to learn the true nature of the employee's occupation.

Correct diagnosis is most important, for if a belief is unjustly created in the employee's mind that the materials with which he is working are injurious to his health it is most difficult to eradicate, and it is mentioned by him on all occasions of mental or physical illness during his entire employment. There cannot but arise, therefore, a feeling on the part of the employer that some physicians attribute all illnesses of industrial workers directly or indirectly to their occupations.

As information is gathered by physicians and others doing research work our knowledge will be more accurate, thus enabling both the employer and the employee to reach a more satisfactory understanding without the conflicting testimony now so often heard in our courts. A clearer conception of what constitutes an occupational disease will prevent serious mistakes in diagnoses which are unfair to all alike.

If more attention is not given to these problems the present tendency will become more pronounced for industry or governmental agencies to establish bureaus where workers in certain types of occupations will receive physical examinations and be given working credentials. Various State Departments of Labor are at present making medical-engineering surveys, and there is at least one state where the Insurance Commission offers to employers complete medical care for industrial accidents, so that it would seem as if occupational diseases will be included in the near future. This will tend to result in complete medical care of the industrial worker by such agencies.

Active medical-engineering control of these problems at this time will have an important bearing on future practices and on future legislation. Which way the pendulum will swing will depend on how actively cooperation is established between industrial management and physicians.

Gas Bacillus Infection

—Diagnosis and Treatment—

by

GEO. G. DAVIS, M.D., F.A.C.S.,
Associate Clinical Professor of Surgery, Rush Medical College, University of Chicago; Attending Surgeon, Cook County Hospital; Chief Surgeon, Elgin, Joliet & Eastern Railway,
and
HENRY A. HANELIN, M.D.,
Chicago

A RECENT case of gas bacillus infection of an extremity has stimulated us to present in a comprehensive form a summary of the salient features of infections caused by B. welchii and other gas forming organisms, and to evaluate the various methods used in the treatment of this group of infections.*

The present state of our knowledge concerning infections caused by anaerobic gas-forming bacilli, as so aptly stated by Reeves,[1] is one of confusion. All bacilli that grow in the absence of oxygen and form spores, are grouped in the genus Clostridium, of which at present, about 100 members are classified.

Etiology

GAS bacillus infections are seen usually in wounds of the extremities, in which a foreign body has been introduced, causing a disruption of the anatomical continuity of the structure, or in those conditions in which the distorted anatomical continuity of the structure has been brought into contact with a foreign substance which is of such a nature as to cause the propogation and growth of the various gas forming anaerobic bacilli. The World War served as an impetus in the study of this condition, and much has been learned from the various observers from the casualty hospitals along the battlefronts. The causative organism of first importance in this group of infections is the Clostridium welchii, or bacillus perfringens. The organism is distributed very widely in nature, and is seen in all parts of the world, and may be cultured from the intestinal tract of herbiverous and carniverous animals, including man.

The bacilli[2] are straight or slightly curved rods with rounded or sometimes square cut ends, enclosed very frequently in a transparent-like capsule. Spores are usually absent in tissues and often in cultures. Dunham[3] showed that the culture isolated by Welch formed spores when grown on blood serum; and some strains, since isolated, formed spores very readily. They are anaerobic, nonmotile and gram-positive, but more easily decolorized than any other gram-positive bacteria. Growth is rapid at 37° Centigrade, in the usual culture media containing sugars, and is accompanied by the production of gas. Nutrient gelatine is not liquified; and on agar plates colonies are developed which are from one to two millimeters or more in diameter, grayish white in color, and in the form of flattened spheres, ovals, or irregular masses covered with hair-like projections. Boullion media is diffusely clouded and a white sediment is usually formed. Milk becomes rapidly acidified and coagulated, assuming a worm-eaten appearance which has been called "stormy fermentation". A large amount of butyric acid is produced. The bacilli ferment most sugars; and they have been divided by Simonds according to their ability to ferment either insulin or glycerol, or both or neither, but they apparently all produe the same toxin.

When quantities up to 2.5 cc. of fresh boullion cultures are injected into the circulation of rabbits and the animals are killed shortly after the injection, the bacilli develop rapidly, with an abundant formation of gas in the blood vessels and the organs, especially the liver. The material suspected of containing the bacillus alone, or associated with other bacteria, is injected intravenously into the rabbits, which are killed five minutes later, and kept at 37° Centigrade for 16 hours, and the cultures in milk made from the liver and heart blood; if "stormy fermentation" occurs in the milk after incubation, the test for B. welchii is positive.

In war wounds the B. welchii is usually accompanied by B. sporogenes, which is a markedly proteolytic anaerobe which is nonpathogenic in itself, but which probably stimulates the pathogenicity of other anaerobes. The presence of this anaerobe makes the isolation of B. welchii in pure cultures often a difficult procedure.

Its pathogenicity is usually not marked in healthy animals, although Dunham found that the bacillus taken freshly from human infection is sometimes very virulent; bacilli of this type are one of the frequent infections after irregular unclean wounds, such as those received in war or in civil practice where much tissue is destroyed or crushed. In these infections there is a marked destruction of tissues, especially in the muscles and this is supposed to be due to one or more of five conditions:

1. To the large quantity of butyric acid produced from the glycogen of the muscles.
2. To pressure due to the amount of gas produced.
3. To the presence of a foreign protein.
4. To a specific toxin.
5. To the presence of a soluble, ionizable calcium salt, which according to Bullock and Cramer[4] produces a local breakdown of the normal defense mechanism against spore-bearing animals.

Other organisms of the gas forming anaerobic group which are either associated with or cause similar types of infections are Bacillus Novii which secretes a very active soluble toxin; B. Fallax which is only slightly pathogenic, and B. Histolyticus which is intensely proteolytic, digesting tissue down to the bone in test animals; B. Putrificus, not pathogenic; and the bacillus of malignant edema, Clostridium oedamatis maligni, or Vibrion septique, which causes an extensive haemmorhagic edema of the subcutaneous tissues, at the site of the wound, so that subsequently there is a

* Read at the Sixteenth Annual Meeting, Medical and Surgical Section, Association of American Railroads, Chicago, Ill., May 11, 1936.

serious effusion which is frothy from gas formation and has a foul odor. Barney and Heller[5] have shown that as many as four anaerobic organisms capable of rapid invasion in the guinea-pig body were isolated from an amputated arm. Weinberg,[6] Bull and Pritchett[7] demonstrated that B. welchii forms an exotoxin which is neutralized by an antitoxin.

Glenny, Barr, Llewellyn-Jones, Dalling, and Ross[8] bring to light that there are multiple toxins produced by some organisms of the Clostridium welchii group, and in a series of experiments showed that the Clostridium welchii (type agnii) of Dalling (the lamb dysentery bacillus), and the B. palludis of McKewen (the sheep dysentery bacillus), produced in broth at least four toxins. The antitoxic response of horses to injection with these filtrates depends largely upon the degree of natural immunity of the animal to the various antigenic constituents injected. It follows that the absence of any given antibody in any one sample of serum does not necessarily indicate the absence of the corresponding antigen in the filtrate used to immunize the animal from which the serum comes. More than one toxin contributes to the death of the animal when titrations depend upon the relative proportions of the various antitoxins in the serum in relation to the proportions of the different toxins present in the test toxin used. The authors state that the following toxins have been found in the few filtrates studied by them:

"1. Alpha toxin is the toxin of C. welchii (classical type); it is neutralized quantitatively by gas gangrene antitoxin (perfringens) and is present in agni filtrates, and to a slightly greater extent in paludis filtrates. The amount present in such filtrates represents 1/40th of the average content of a pure C. welchii filtrate, and about two mouse m.l.d. are contained per cc.

"2. Beta toxin, a necrotic, non-haemolytic toxin causing purple reactions in guinea pigs usually the second day after intracutaneous injection. This is neutralized only by sera obtained from animals which have been immunized with the toxins of 'B. paludis', or the lamb dysentery bacillus, and to a very limited extent by the sera of some normal horses. This toxin is the predominant constituent of agni and paludis filtrates.

"3. Gamma toxin, a constituent of agni filtrates lethal to mice and not neutralized by alpha and beta antitoxins.

"4. Delta toxins is a haemolysin produced by 'B. paludis'. Although we have not demonstrated its presence, this constituent is probably present to a much smaller extent in agni filtrates because serum from horses immunized with these filtrates protects against paludis haemolysin. Sera with low protective power in mice in relation to their beta antitoxic content are all deficient in delta antitoxin."

These observations are of especial interest, since they show the remarkable work being done by research bacteriologists in helping to solve the various problems as they arise in the treatment of gas gangrene infections. The profound toxemia and the disturbing clinical states as seen at the bedside in these cases may in some instances be readily explained by the actions of these variable toxins on the human organism depending upon the strain of Clostridium welchii that it is infected with. The last mentioned group of authors state that the tetanus bacillus offers another example of an organism producing multiple toxins, and they also suggest that some types of Clostridium botulinum produce variant toxins common to other types. It is possible that all or most organisms produce more than one toxin under suitable conditions, and that antitoxic sera may sometimes fail in practice if deficient in a subsidiary antibody.

Pathology

IN DISCUSSING the pathology of gas gangrene, especially of the muscle, one is confronted with a manifold clinical syndrome which if not handled systematically will further confuse the individuals interested in this problem. We have found that the report by Emrys-Roberts and Cowell[9], of the Royal Army Medical Corps, is a very excellent study in the morbid anatomy of gas gangrene of muscles. Their experience was obtained from cases observed on the Western Front during the World War, and with a wealth of material at hand and with keen clinical and laboratory observations, certain points of significance were of aid in further understanding the morbid processes in gas gangrene of the extremities. We shall freely discuss and quote from their excellent work: "Grossly the naked eye appearances of the infected muscle will be described:

1. At the wound surface,
2. In the area of dead muscle,
3. At the spreading edge,
4. In the contractile part beyond.

"The variations in appearance at these different levels, and after different lengths of time have elapsed, depend on the following factors:

1. The extent of local trauma.
2. The degree of chemical changes in haemoglobin resulting from the acid produced locally.
3. The presence of gas in the tissue.
4. The amount of myolysis produced by the bacterial 'toxins'.

"AT THE WOUND SURFACE: There are two types of wounds of muscles in which gas gangrene is especially liable to develop, firstly, in deep penetrating wounds or without fracture of bones, in which the main vessels may or may not be involved; and secondly, an extensive surface wound, where gross laceration of the muscle has been produced, and very large amounts of infective material such as dirt and fragments of clothing have been carried in.

"In examining the early cases of the first group, the damaged and infected fibres along the tract of the missile may be seen pale in color and non-contractile, while the wound surface is covered with a thin film of a viscid greenish-yellow fluid. On close examination faint pink lines indicating the spread of infection into the muscle run along the course of the perifascicular connective tissue."

This was seen in a specimen taken from one of the author's cases, "where a shell fragment lay imbedded in a portion of the vastus externus. From the tract thus produced the infection could be seen spreading inwards and resembling a 'stab' culture. In other cases where laceration is more superficial the wound surface is at first a dusky red, later becoming paler, then green, and then, finally, black. This is due to the local contusion producing interstititial haemorrhages, the blood from which is soon attacked by the products of bacterial growth. Frequently, here, may be seen

small dark colored blood clots half-imbedded in the torn muscle substance, or attached merely by a thin, fibrinous pedicle. The presence of these 'black currant' clots is not confined to muscle infected with gas gangrene, but has been observed in laceration of other vascular tissues such as the brain. These clots may be a factor of importance, if not wholly removed at operation, since they have been found swarming with anaerobic bacilli.

"In the earliest stages the surface is hard to the touch, especially to the ungloved finger, faintly recalling the feel of a hard chancre. This surface of the dead muscle is coated with a thin white fibrinous layer. There is no actual pus exuded from the wound surface, although a clear sanious foul-smelling fluid escapes. Underneath the fascial sheaths a layer of thick greenish turbid lymph is found; a similar fluid may often be observed spreading round the nerve sheaths or such structures as the plantaris tendon.

"As the infective process continues to develop, softening occurs. The surface becomes crepitant to the finger, and soon reaches the final stage of black deliquescence. The chief gas formation takes place below the surface, and is described in the next paragraph. From the above it will be noted that we are dealing with an unusual form of wound.

"The Dead Muscles: In the very earliest cases, if the muscle is examined immediately below the wound surface, it is found to be firmer than normal and no longer contractile. There is no change in the colour, but there is a distinct lack of lustre and translucency. Soon, however, in advanced cases, the sequence of colour changes already noted begins. The normal red is lightened and becomes pink, thereafter running throughout the greys and green to the final black. If several muscles are affected all the colour changes may be observed simultaneously.

"Gas production begins at a variable time after the death of the muscle; usually it does not occur until many hours have elapsed, so that it must be regarded as a late manifestation. At first minute bubbles are found; these coalesce and rapidly increase in size, giving the dead muscle a spongy or honeycombed appearance. As gas is produced in greater quantities it forces its way along the planes of least resistance, till it bursts through the surface of the dead muscle. In this way the fascial sheaths become distended with gas, and, in the case of a long muscle, the presence of the gas becomes an additional factor, as mechanical ischaemia is produced from the blood supply being thus obstructed. In a muscle such as the tibialis posticus, the pressure exerted in its rigid fascial compartment is sufficient to partially occlude the main vessels, and thereby accelerate the spread of gangrene. From the fascial sheath the gas soon finds its way into the cellular tissue and becomes subcutaneous, extending in some cases even over the whole body, just before death. Postmortem, the escaping gas, following upon puncture of the distended skin, burns readily with a blue flame when a light is applied. In several instances we have seen the gas forced along between the fibres of a peripheral nerve.

"We have made a number of observations on the specific gravity of gas gangrene muscle in all stages. We find that, in the stage where, microscopically, nothing but dead fibres with their distended perifibrillar spaces exist, there is no appreciable change. Had these spaces been distended with gas the specific gravity would have been lowered; we therefore infer that the distention is fluid in character. In certain later stages, where gas has not been produced, we find a slightly reduced specific gravity. This may be explained by the presence of the leucocytic exudation, since leucocytes are of a comparatively low specific gravity. As the presence of interstitial gas becomes apparent, so the specific gravity decreases, until, in the later stages, the muscle is found to float in ordinary water.

"In this dead muscle area we have investigated the extent of possible arterial thrombosis, having in mind the fact that in gross inflammatory lesions, in general, thromboses are common. As a typical example we quote the case of an advanced gas gangrene of the leg, where the whole limb was distended, drummy, cold and pulseless, and where we might well have expected a measure of thrombosis. The popliteal artery was injected with a red lead suspension immediately after amputation. We found, however, that the injection had penetrated perfectly and could be seen even in the minutest arterial twigs. We therefore conclude that trauma is not a concomitant of the process of gas gangrene.

"The absence of circulation in this case was undoubtedly due to the mechanical pressure of the contained gas.

"The Spreading Edge: In advancing cases, as we proceed away from the wound, a point is at last reached where non-contractility ceases and the muscle again reacts to stimuli. This line of junction is found to proceed across the muscle in an extremely irregular fashion. The line of lost contractility, as tested by the needle-point stimuli, can be demonstrated at an appreciable distance—often several millimeters—in front of the hard line of the dead muscle fibres already described.

"Contractile Area: Lastly, we have examined the contractile muscle in advance of the spreading edge for evidence of vascular lesions. These, in the absence of direct evidence of trauma, and its resultant bruising effects, have never been encountered.

"It must be noted that traumatic interstitial haemorrhage is quite commonly met with at a considerable distance from the site of the wound, and may even be found in adjacent muscles which have not themselves been penetrated or lacerated by the missile.

"For example, in a case of early gas gangrene, following a perforating wound of the forearm with fracture of both bones, we placed the limb in formalin immediately after amputation. Next day each muscle was removed separately, labelled, and replaced in the preserving fluid. Four days later they were cut longitudinally, and we were able to demonstrate that muscle, not involved in the track of the foreign body, showed extensive blood extravasations. The brachio-radialis, for instance—well away from the actual path of the missile—while it showed a few areas of surface ecchymosis, was found to be widely suffused with streaks of haemorrhage throughout its lower half.

"Mode of Spread: The process of gas gangrene is seen to spread, within the fascial sheath, in the direction of the fibres of the affected muscle. Thus the infection is confined to the affected muscle to

the exclusion of neighbouring muscles, unless the main blood supply is interfered with, either by trauma or by pressure of gas from the affected muscle, or group of muscles as the case may be; or unless the glairy infective exudate, which we have previously described tracking along the sheaths of such structures as arteries, nerves, and tendons, extends the process from one segment of a limb to another.

"THE PROCESS OF NATURAL ARREST AND ATTEMPTS AT REPAIR: From the clinical study of the cases it is seen that under certain circumstances the body makes an effort at repair. This process is easily appreciated by the naked eye. It can occur under two distinct conditions. Firstly, where the arrest of the process has taken place at the surface of an open wound, and secondly, where it has occurred while an appreciable area of dead muscle is still present. It takes the form of a white line of demarcation abutting against living contractile muscle fibres. From histological evidence it can be proved that this line is not an active 'leucocytic barrier', and is rather the result than the cause of the process of arrest.

"This was well shown in a portion of the upper part of the gastroenemius excised three days after the wound had been received. At the operation care was taken to cut through the contractile tissue only. The white infiltrated area was seen to extend to an average depth of one and a half centimetres, where it stopped quite suddenly as red contractile fibres were reached.

"Sometimes, in addition to this well-marked line, there are to be found numerous prolongations extending into the muscle along the course of the interstitial blood vessels. This is shown in a specimen consisting of the whole of the rectus femoris removed from a case at operation. A thin layer of dead muscle is separated from the living by a well-established line of demarcation, and here the prolongations are so universal that when the muscle is dissected they are found even in the centre.

"The later stages of recovery are characterized by the shedding of the fibrinous leucocytic layer in the form of sloughs, coinciding with the development beneath of granulation tissues."

Histology

THE pathological changes noted were remarkably consistent, and the type of organism present did not appreciably affect the general character of the morbid process. An outstanding factor governing the histological picture was undoubtedly the presence of absence of bruising, with its concomitant blood extravasation and thrombotic changes.

"Bearing these points in mind we may outline the changes met with in the following areas:

A. At the wound surface.
B. In the area of dead muscle.
C. At the spreading edge.
D. At the site of resistance or recovery.

"A. AT THE SITE OF THE WOUND: Let us suppose we are dealing with a typical case of advanced gas gangrene. The superficial, obviously necrotic, muscle will be found to be composed of distorted, swollen, fragmented fibres, with separated perifibrillar sheaths embedded in a mass of fibrinous reticulm, in whose meshes are large numbers of polymorpho-nuclear leucocytes, especially on the actual surface, together with varying numbers of both aerobic and anaerobic organisms and extravasated blood cells, and cell debris. Phagocytosis of both bacteria and pieces of dead and lysed muscle is well seen. It will be noted that whereas the muscle fibres show lysis, the leucocytes are definitely alive and their nuclei stain well.

"The vessels at the surface are damaged, and thrombosis quickly occurs. As the muscle fibres of the vessel walls also undergo lytic changes, in the immediate surface area no definite vessels remain.

"The characteristic fibrinous reticulum, by effectively binding the leucocytes and pieces of dead muscle, prevents the formation of 'pus', and accounts for its absence in gas gangrene.

"If we examine the site of the wound in a less advanced case, the first thing to attract notice is the filmy white fibrinous exudate on the surface, which also extends downwards for varying depths into the subjacent infected muscle. This deposit is identical with the fibrinous reticulum, suffused with leucocytes and muscle detritus, just described. In extremely early cases of gas gangrene the fibrinous deposit, though invisible to the naked eye, is readily seen under the microscope. The presence of leucocytes, then, on the wound surface is quite characteristic. Although, as we shall see later, leucocytes are the more rarely seen as we approach the spreading edge, indicating the anti-chemiotactic properties of the anaerobic 'toxins', it should not be forgotten that in its original manifestation the ineffective process consists invariably in a mixture of the effects of both aerobic and anaerobic bacteria.

"This superficial fibrinous reticulm, though characteristic, is not peculiar to gas gangrene. It can, and does, occur in massive aerobic infections, where the underlying tissue response has become enfeebled.

"The inference we draw is that in gas gangrene a similar enfeeblement has occurred, indicating a state of lack of resistance.

"B. THE AREA OF DEAD MUSCLE: As we proceed from the actual site of the wound into the area of dead muscle, the presence or absence of bruising more than ever dominates the histological picture. When the bruising of the muscle is slight, examination of the dead tissue reveals only a moderate degree of extravasation and thrombosis.

"The specific action of the anaerobic 'toxins' appears to be myolytic in character. Hence in muscle fibres already killed or injured by the force of the blow—and this applies equally to the muscle fibres of vessel walls—the process of myolysis is hastened, and the hemorrhages, extravasations, and thromboses are thereby aggravated.

"The muscle fibres themselves in this dead area, except in very early cases, where occasional striated fibres may be seen extending almost to the wound surface, have completely lost all normal characteristics of striation and staining properties. They are frequently swollen, distorted, and fragmented, present longitudinal splitting, and are separated from the surrounding interstitial tissues by distinct perifibrillar spaces. Many of these fibres, and also particles of lysed fibres, nearest the wound surface, are in process of active phagocytosis. Myolysis frequently proceeds to such a degree as to produce entire disappearance of the portions of fibres involved.

"The fibrinous reticulum, previously described on the wound surface, is here observed to extend

both between muscle bundles — perifascicular fashion—and between muscle fibres—in perifibrillar fashion—to a slight degree and for a short distance. The enmeshed leucocytes decrease rapidly in number as we proceed in the direction of the spreading edge, the fibrinous reticulum becomes more attenuated, its place being taken by fluid. In this fluid are suspended the 'toxins' of the anaerobic bacilli, occasional leucocytes, and from time to time extravasted blood cells. The bacteria are present in ever decreasing numbers the further we proceed from the wound surface, and are found lying both in the perifibrillar and perifascicular areas. The fluid is presumably produced by exudation from the capillaries; its accumulation for the well recognised hardness and solidity of the muscle as previously described, and its outpouring through the wound surface provides the familiar discharge associated with gas gangrene.

"As we advance further towards the spreading edge, the muscle fibres become singularly intermingled, the living with the dead and dying. So far from there being any hard-and-fast line between affected and unaffected fibres, these are seen to exist side by side and in every plane. The same may be said even of bundles of fibres so that, while the line of demarcation between contractile and non-contractile muscle may be assigned to a given spot, it must be understood that contractility is a relative term, and that muscle which contains a due proportion of dead fibres may yet be contractile by virtue of the power latent in the still living fibres.

"The lytic changes, described as occurring in vessels subject to trauma, may also be demonstrated as occurring in vessels not so subjected. Thus the stages between normal blood vessels on the one hand, and vessels whose walls have been completely lysed on the other, can be seen. We find that these changes in the blood vessels are due to the myolytic action of the 'toxins', and do not appear until the changes in the muscle fibres have become established. In the case of the capillaries, owing to their free anastomosis and to the absence of muscle elements, lytic changes do not take place until a late stage of the process is reached, and they continue to supply this area with blood practically up to the wound surface. In this way the blood of active leucocytes, which is so marked a feature at this spot, is accounted for.

"While examining the muscle fibres, we frequently find, running alongside, a row of nuclei which would at first sight appear to be proliferated sarcolemmal nuclei. They are not, however, sarcolemmal in origin, but are the nuclei of endothelial cells of the capillaries which can be demonstrated both coursing alongside muscle fibres, and crossing them in an interlacing manner.

"C. The Spreading Edge: Presently we arrive at perhaps the most interesting stage of all, the spreading stage. Here the proportion of dead to living fibres is reversed—until we find occasional dead or dying fibres in the midst of living ones. In the present state of our knowledge a fibre provided with striations may be said to have been unaffected by 'toxins' at the time it was fixed. Conversely, loss and blurring of striation may be taken to indicate that the fibre has been killed or has reached the dying stage.

"We can trace the individual fibre from the area of dead muscle into that of the living through the following stages. At first the fibre is swollen, has lost its striation and staining characteristics, and is surrounded by the fluid-containing perifibrillar space. As we proceed, it gradually loses its perifibrillar space, its swollen appearance, and longitudinal splitting, until it approximates to the living fibre in all save its possession of striae. In this condition we can trace it onwards until at last well-marked striae appear, and we are able to say, 'Here is the spreading edge'.

"At the spreading edge there is no indication whatever of vascular change in those cases where the effects of bruising can be excluded. Vascular changes, dependent to a greater or less degree on the myolytic properties of the anaerobic 'toxins' are comparatively late phenomena since the muscle fibres of the vessels are not at first exposed to the action of the 'toxins' to the same degree as are the fibres of the muscle proper.

"The demonstration histologically, of anaerobic bacilli as we approach the spreading edge is a purely fortuitous occurrence. We know that they exist there—and beyond it—because their presence can be proved in cultures made from pieces of muscle taken for the purpose.

"These bacilli at and beyond the spreading edge are eventually destroyed. Only in grave infections, with profound loss of bodily resistance, do such bacilli become a source of danger. We know how in these cases secondary foci of gas gangrene may develop well away from the original site of infection, in such spots as where saline injections have been given subcutaneously, or where pressure from a splint has taken place. The bacilli at and beyond the spreading edge are so few in number, that it may be safely stated that the 'toxins' they evolve are negligible. How, then, is the continuous and advancing death of the individual muscle fibres to be accounted for? The explanation is that the soluable 'toxins' of the anaerobes exist in the perifibrillar spaces, are here absorbed by the muscle fibre, travelling in the direction of its long axis, and kill the fibre as they advance. Heavy bacterial infection, combined with inefficient drainage at the wound surface, leads to increased absorption of the 'toxins', and so hastens the advancing death of the individual fibres. Similarly the more damaged the tissues and the greater the degree of blood extravasation and thrombosis, the less the resistance there is to the lethal process. Hence the astonishing rapidity of the advance in certain cases, more especially if, together with the local loss of resistance, we have a lowered general resistance resulting from fatigue shock and haemorrhage.

"D. Area of Resistance or Recovery: Following upon operative interference, where either the wound has been thoroughly opened up, amputation performed, or muscle excised, we may be in a position to demonstrate the tissue reaction that accompanies the checking and eventual overcoming of the process of gas gangrene.

"This process is marked by the further development of the fibrinous leucocytic layer, in such a manner as to form a distinct line of demarcation between this layer and the underlying contractile muscle.

"Occasionally, arrest of the process occurs spontaneously, and a similar line of leucocytic infiltration is formed at the wound surface.

"Microscopically there is usually a sudden transition from the infiltrated layer to the healthy

muscle; while within the layer of fibrinous exudate the muscle fibres, where recovery is taking place, are found to be dead and in process of phagocytosis. Living fibres can be met with, however, at quite a short distance as we proceed inwards, indicating the cessation of the myolytic process. Here, in contradistinction to the generally long drawn-out process of muscle fibre disintegration associated with advancing gas gangrene, the change from the living striated fibre to the swollen and lytic stages is usually accomplished abruptly.

"The perifibrillar and perifascicular spaces contain the anaerobic 'toxins' which by reason of their antichemiotatic properties repel leucocytes. Hence if, as we near the wound surface, these spaces are seen to contain an increasing number of leucocytes, we may regard it as a measure of the neutralization of the 'toxins' by the antisubstances evolved in the tissues and conveyed to the spaces by the capillaries. Hence also, if, at the wound surface and for a certain depth into the subjacent muscle, we meet with pronounced leucocytosis, we know that the presence of these leucocytes demonstrates the actual degree of the neutralization of the 'toxins', othewise these cells would cease to be attracted to this area, and would certainly be inhibited from exercising their phagocytic properties. We are, therefore, justified in saying that the greater the mass of leucocytic aggregation at and near the wound surface, the better the fight is proceeding.

"The fibrinous character of the leucocytic exudate, with its binding effect, is an indication that the underlying tissues are in an enfeebled condition, as we have already stated. When the stage of resistance or recovery is reached the fibrinous exudate still exists, though now superimposed upon living muscle fibres, indicating the limit of the process of destruction. Later, when the stage of recovery is still further advanced, this exudate, together with dead muscle, is shed in the form of sloughs; revealing, beneath, the establishment of true granulation tissue, with hopes of new capillaries and remains of muscle fibres undergoing absorption. This is a sign that the underlying tissues have fully regained their vital properties.

"Leucocytes, no longer bound in the meshes of a fibrinous reticulm, are freely permitted not only to return to the tissues, but when no longer required, to be shed as 'pus'.

"Regeneration of such a highly specialised structure as muscle fibre must necessarily be of very imperfect character, and we question the possibility of any real replacement of lost muscle tissue."

Symptoms

EMRYS-ROBERTS and Cowell[9] consider three main clinical types in a discussion of the smyptomotology of gas gangrene infections:

"A. The common type which occurs in neglected wounds 12-24 hours after the injury or a few hours after the first operation.

B. The fulminating type, where the patient, if untreated may be dead in a few hours.

C. The delayed type: with a slow onset so that the condition only becomes established several days or weeks after the date of the injury.

"A. THE COMMON TYPE: Occasionally a patient comes before the surgeon with the condition well established. Clinically the patient may exhibit much suffering from an anatomically trivial wound; he looks ill; he is flushed, has a raised temperature, and a rapid pulse; the wound itself looks dirty, and exhibits a curious characteristic, unpleasant, pungent smell. A few hours later, as the absorption of the 'toxins' increases, the flush is replaced by a pallor, finally a pale lemon color of the skin appears, and sclerae become distinctly icteric.

"The patient is now profoundly ill. His tongue is dry and foul, the pulse is running and soon imperceptible, respiration is rapid and shallow. Vomiting is usually a distressing feature, and in the last stages, becoming black from petechial haemorrhages. Mentally these patients are perfectly clear, and it is not uncommon to see a man smoking a cigarette or reading a newspaper a few minutes before death. Mild delirium may be frequent but not common. In cases of a deep penetrating wound, as for instance in the calf of the leg, the seriousness of the general condition gives rise to the suspicion that deep gas gangrene is established. It is in such wounds of the lower extremity where the main blood vessels are especially liable to injury, that the massive or vascular variety develops. The ischemia thus produced favors the growth of the organisms, and once gangrene is established, the feeble, collateral circulation is progressively impeded until the whole limb is dead.

"In the later stages of an infected penetrating wound changes in the overlying skin occur which indicate the site of origin of the toxemia. The pallor of tense skin is followed by a reddish blush, soon becoming a dusky violet, which spreads rapidly from the edge of the wound. The coloring may be uniform or mottled. At this stage, if the dead and infected tissues are removed, as by amputation, the color soon fades and after 24 hours leaves nothing but a slight desquamation; otherwise blisters next appear and increase rapidly in size. Finally, as the tissues begin to undergo lytic changes, the green and black colors of decomposition appear. The presence of gas may be appreciated after a few hours, but should always be regarded as a late phenomena. If such cases are untreated, the infection runs its course and ends fatally in 12-24 hours after the date of injury.

"B. THE FULMINATING TYPE: In the common type the rapidity of the spread of infection is striking; but in the fulminating type the speed of the sequence of events is even more dramatic. The patient is admitted to the hospital in the gravest possible condition with well developed gas gangrene a few hours after being injured. This is especially likely under the following conditions where both shock and loss of blood are present:

1. In cases of gross gun shot injuries of bones with extensive laceration of muscles.
2. In multiple wounds of the trunk and lower extremities.
3. In penetrating wounds of the limbs completely involving the main blood supply or in the rare cases where a tourniquet has been applied and overlooked.

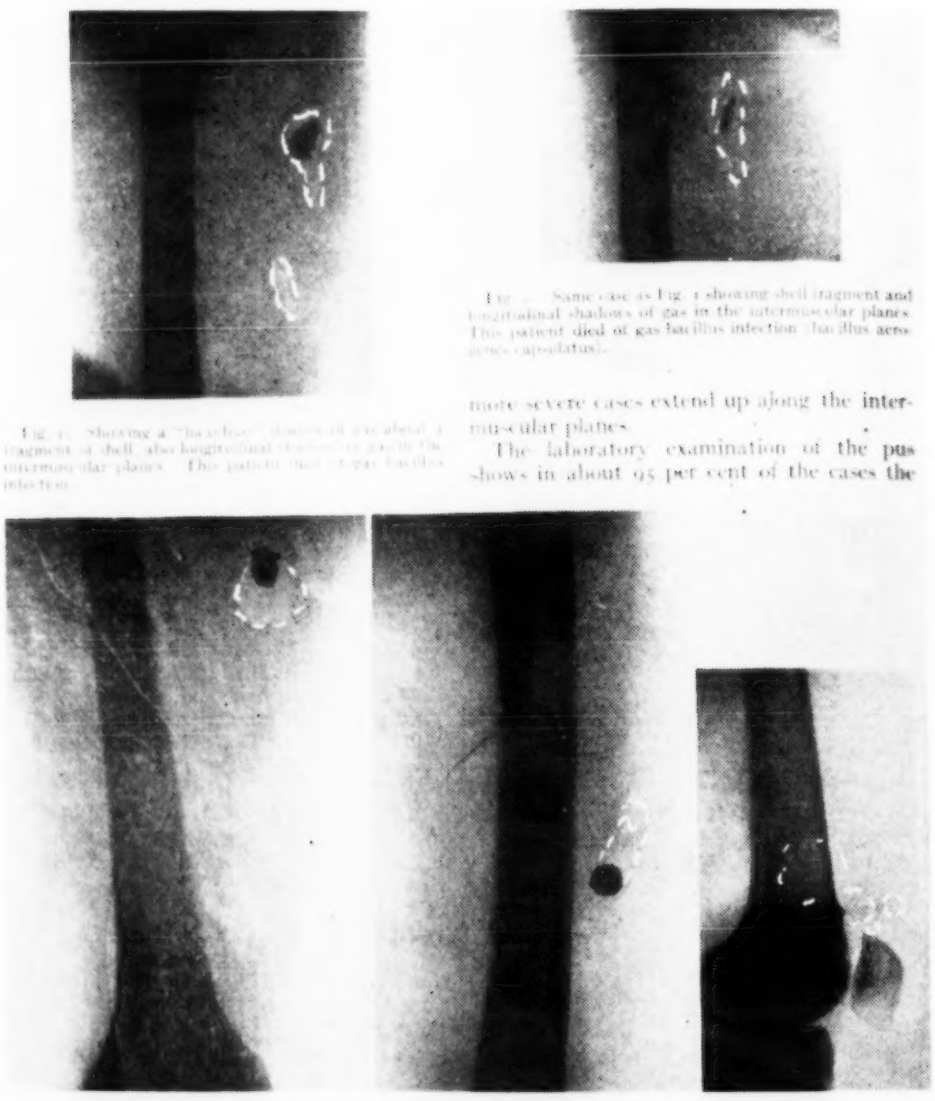
In these cases before the initial shock has had time to pass, and the patient has recovered from the effects of the primary haemorrhage, the infection of gas gangrene becomes well established. It is this symptom complex of shock, haemorrhage, and exhaustion, associated with anaerobic infection, that combines to produce these fulminating cases.

Such patients when seen on admission are cold, pale, restless, and probably vomiting. The mu-

ceous membranes and extremities are cyanosed; the pulse is imperceptible at the wrist, and the systolic blood pressure is about 50 mm. of mercury. Locally, the wound exhibits the characteristic smell and signs of dead muscle, with the surface color changes already described. In these cases extensive gas formation may occur after a very short space of time. When in this state, the patient cannot stand much surgical interference, and death takes place in 10-24 hours or even less, after the time of injury.

"C. The Delayed Type: Here both the local and general resisting powers of the patient have succeeded up to a point and the latent infection is at first limited to the surface of the wound. At the original operation the wound has been freely laid open and cleaned up. After a day or two the surface does not granulate as it should, and soon constitutional symptoms develop, showing that the latent period has come to an end and the infection has begun to spread inwards. This process may occur even several weeks after the original wound.

"Natural Recovery: In certain cases, apart from radical operative interference, a natural process of recovery ensues and when the type of wound, a surface wound, with the skin and fascia widely open or, at the surface of an amputation stump, is favorable.



Figs. 1 to 6. About the foreign bodies are halo-like areas of gas which denote localized or staphylococcus-like areas of gas bacillus infection. With such findings local surgical procedures as debridement, incisions, excisions, etc., with drainage, are indicated

"Diagnosis: From the foregoing account it is seen that in established cases the clinical picture is so striking that the pungent smell, color changes of dead muscle and grave constitutional changes never remain long in doubt. It is in the earliest stages of the common type that the importance of immediate diagnosis lies. Here, if attention is paid to the local physical signs found in the wound, a diagnosis can be made before the general symptoms have had time to develop."

Davis,[10] in 1916, brought out the value of Roentgen ray diagnosis in gas and pus infections in which a "halo-like" shadow was usually present, either locally around the foreign body in the substance of the tissues or a regular or elongated expanding halo along the track of the foreign body or in the fascial planes. The value of this added armamentarium to the diagnosis of gas bacillus infections can not be too strongly stressed.

Sprague,[11] and Schneider,[12] recently reemphasized the importance of roentgenography in diagnosis of gas gangrene of the extremities. Reeves,[1] states that "approximately 30% of the cases treated as Clostridium welchii gas gangrene are caused by other anarerobic organisms, and this 30% of cases should be classed as putrefactive gangrene and treated conservatively by systemic, supportive treatment, debridment, and irrigations. Clostridium welchii antitoxins are not indicated and may be injurious. Putrefactive gangrene is likely to occur in persons past 50 who are constitutionally below normal. Cases appear notably in patients with circulatory failure, thrombo-angiitis-obliterans, diabetes mellitus, and arteriosclerosis. The direct cause for putrefactive gaseous lesions in the muscles of patients whose conditions are described above may be bruises, burns, simple fractures, parenteral administration of drugs and solutions, and circulatory failure.

"Putrefactive gas forming anaerobic soil bacteria contaminate food at all times. It seems apparent that bacteria of this type are frequently present in the organs and muscles of the aged individual."

Air emphysema of the extremities is differentiated by the lack of local tissue changes and uncomplicated clinical course.

TWENTY years ago Davis[10] described the x-ray findings of gas as follows:

"It is a routine procedure at the Twenty-third General Hospital to Roentgen ray all bullet or shell wounds, when the missile is suspected of remaining in the body. Also it is our custom to have two views; an anteroposterior and a lateral, before starting any surgical interference aiming to remove the foreign body.

Figs. 7 and 8. The Roentgen-ray here presents a honeycomb like picture, a generalized involvement comparable to a streptococcus infection in extent. With this finding, amputation, guillotine type, is indicated

"As a large percentage of our cases are bullet or shell injuries, we have an excellent opportunity of studying and drawing conclusions from our Roentgen ray findings.

"In all cases in which the Roentgen ray has shown a 'halo-like' shadow about the missile, we have found clinically, at the operating table and

in the laboratory, evidence of an infection caused by gas and pus-forming organisms.

"The Roentgen ray pictures of these cases may best be described by dividing them into two groups: In the first the gas and pus infection is local or limited and a single 'halo-like' shadow is noted about the bullet, sometimes encircling it like a halo, or more often extending in one or more directions from it, either above or below or laterally (Fig. 3). This shadow may have a diameter of half an inch or as large as two inches. The local picture may be composed of a number of small irregularly round or elongated shadow areas (Figs. 4 and 5) in close relation to the bullet or extending along the track of the missile.

"The Roentgen ray picture in the second group of cases, that is in those cases in which the gas and pus infection is more or less extensive, shows a shadow similar to that noted in the first group, plus shadows extending upward and downward for a considerable distance, (Figs. 1 and 2), according to the extent of the infection.

"Clinically these cases early manifest definite symptoms. The patient complains of severe pains in the region of the missile. He feels sick, weak, and is very restless. There is a marked rise in temperature and increase in the pulse rate. Locally one finds a swelling which may be confined to the area about the missile, or in the more severe or extensive cases, the entire diameter of the limb may be increased and indurated. A point of exquisite tenderness will at times help the operator to localize the missile. On palpation with moderate pressure, a crackling sensation—crepitation—is imparted to the examining hand, and gas bubbles may be seen to escape through pus at the wound of entrance of the missile.

"At operation one finds along the entrance wound and about the missile, a generous pocket of thick pus, which has a pinkish color and gives a characteristic gas odor. This may be localized about the missile or in the more severe cases extend up along the muscular planes.

"The laboratory examination of the pus shows in about 95% of the cases the bacillus aerogenes capsulatus, with accompanying pus organisms. Of the latter, the staphylococcus is the most frequent. Other associated organisms are the streptococcus pyorgenes, colon bacillus, tetanus bacillus. The colon bacillus is especially common in wounds about the buttocks. The tetanus bacillus is at times found in the pocket of pus, but clinical symptoms of tetanus do not follow.

"We have found the Roentgen ray picture here described so constantly in cases which give this same clinical, laboratory and operating room finding that we believe it to be of considerable value.

"In cases where the missile has been allowed to remain in the body and clinical symptoms develop, we request a Roentgen ray to see if this finding has developed. If this picture is encountered when raying to locate a missile, it is an indication for urgent surgical interference." (See Figs. 1—8).

Treatment

THE treatment of gas bacillus infections of the extremities resolves into an early recognition of the symptomatology and the immediate institution of prophylactic and active therapeutic measures available. The ever mounting number of cases of gas bacillus infections being seen in civil life today may be attributed, to a certain extent, to the hesitancy to utilize proper measures available, procrastination, or sheer ignorance of the morbid prognosis of crushing injuries of the extremities. The anticipation of complications of any 'dirty' wound will serve as a reminder for instituting prophylactic measures.

Prophylaxis

THE prophylactic treatment for gas bacillus infections of the extremities resolves itself into the evaluation as to what wounds are apt to give rise to gas gangrene. After a careful physical examination and history is taken relating to the manner in which the injury was obtained, and eliciting such criteria as whether the patient was injured near soil contaminated by excreta of farm or domestic animals, the examining physician should be on guard for the possibilities of B. welchii and other anaerobic infections. If there is much maceration and crushing of tissue, with or without fracture, an extensive debridment operation is immediately performed under either local or general anaesthesia, (the type of general anaesthesia will be discussed in a subsequent paragraph). The wound should be irrigated with oxidizing agents such as hydrogen peroxide, potassium permanganate solution 1-500, Dakin solution, potassium chlorate 2%, and similar solutions.

Intravenous infusion of 2.5% glucose and .45% saline solution will sustain the patient during the immediate shock. External heat is advisable, and morphine, grains one-sixth to one-fourth should be used p.r.n. The use of commercial prophylactic tetanus and gas gangrene antitoxins is to be highly commended, since the usual dose contains 1500 units tetanus antitoxin, 2000 units perfringens antitoxin, and 2000 units Vibrion septique antitoxin. This is given in one dose, and usually suffices in the less extensive injuries. However, it may be repeated every other day for three doses, if in the judgment of the surgeon the extent of the injury warrants it. Careful precautions must be used to guard against horse serum reactions, and the usual interdermal tests should be performed before each injection, and any manifestation of anaphylactic reaction should be treated with Epinephrine hydrochloride 1-10000 solution. An ounce of prevention in these types of injuries is worth a pound of cure.

Millar,[29] in a study of gas gangrene in civil practice, tabulates a series of cases as follows:

	Totals	Recovered	Died	Not Stated
Amputations	128	71-58.7%	50-41.3%	7
Incisions and drainage (incision debridement)	125	57-47.1%	64-52.9%	4
Amputation plus serum	40	19-47.5%	21-52.5%	0
Amputation plus incision	38	28-77.7%	8-22.3%	2
Serum	22	15-68.2%	7-31.8%	0
Serum plus incision	22	17-81.0%	4-19.0%	1
Amputation plus incision plus serum	15	7-50.0%	7-50.0%	1
Miscellaneous	9	4-44.4%	5-55.5%	0
Number not stated and not surgically treated	208	73	121	14

From the foregoing figures it would appear that the present results obtained are very unsatisfactory, and this possibly can only be explained on the delay in recognizing the symptoms, allowing the toxemia to progress to such a state that the vital centers are affected and specific means are then without avail.

Hanchett,[28] in a paper before the Western Surgical Association, re-emphasized the value of effective prophylaxis, debridement and delayed suture in all massive contused and lacerated wounds, and compound fracture; polyvalent serum associated with active surgery seems to give the best results in his cases.

Active Treatment

THE active treatment of gas gangrene of the extremities must be instituted as soon as the earliest symptoms arise; diagnosis already established by methods indicated in previous paragraphs. One should then proceed unhesitatingly to administer the proper surgical procedures which today have been very effective in decreasing the mortality and morbidity of the anaerobic infections.

1. Use of Perfringens Antitoxin: Glotowa, Ostrawskaja and Ssilanowa,[13] in an evaluation of gas gangrene sera state "that in the therapeutic treatment of gas edema disease the perfringens and oedematien sera are of especial importance since the B. perfringens as the grangrene stimulus (or excitant) plays the chief part and the B. oedematiens of more common occurrence accordingly has second place, yet it builds up the most toxic microbic irritation in gangrene and therefore causes the worst course of all the gas edema diseases. But also the Vibrio septique and the B. histolyticus are very significant in gangrene pathogenesis, although much less encountered in the wounds of patients. For these reasons the preparation of excellent curative sera and the possibility of their evaluation are of the greatest importance."

The authors summarize their report with the following:

I. The evaluation of gas edema sera (anti oedematiens, Vibrio-septique, and histolyticus) through intravenous incorporation into white mice, analagous to the international standardization method for perfringens anti-serum, gives exact results.

II. An international simple proportional evaluation method for all gas edemas (oedematiens, Vibrio septique, and histolyticus) analagous to the international titration for perfringens serum is very urgently called for. Also, the production of international standard gas gangrene sera and its taxation for all countries undertaking its manufacture, are extremely desirable."

Bearing in mind these things, one should use only those commercial preparations available which contain the aforementioned types of antitoxin. The usual combined gas gangrene antitoxin available today contains 10,000 units perfringens antitoxin and 10,000 units Vibrio septique, and does not contain the other two mentioned organisms. We feel that this is an unfortunate situation and it is hoped that in the near future a polyvalent gas edema antitoxin will be made available according to the standards as brought out by Glotowa, et al.

The antitoxin should be given in massive doses, since the toxemia and local tissue reaction is very great. The use of 50,000 to 100,000 units is obligatory. Here again we wish to caution the surgeon against hesitancy as to intensive therapy. In some cases, the cost of the administration is so exorbitant that in many cases patients will be unable to afford this excellent therapeutic measure. We therefore advocate that in those cases in which the patient's financial means prohibit him from obtaining the benefits of antitoxin therapy, the local or state health departments should have antitoxin available in much the same manner as for diphtheria, hydrophobia and other infectious diseases.

Much literature has accumulated on the use of gas gangrene antitoxin, and one has only to refer to the excellent reports by Pellegrini,[14] Melnikov,[15] Grantham,[16] Warthen[17], Ghormley,[18] E. Eliot, Jr., and E. R. Easton,[19] J. R. Reeves,[1] de Takats,[20] Lohr,[21] Angerer,[22] and Ovechko[23] to corroborate the judicious use of antitoxin in the treatment of gas bacillus infections.

Surgical Treatment

THE exact surgical procedure to follow in any given case is a difficult thing to determine until the presenting symptoms indicate the course of treatment.

1. Where there is much distortion of anatomical continuity of the structures one is more or less forced into radical procedures to preserve the life of the patient rather than the limb, therefore, where there is extensive crushing of the soft tissue parts, accompanied with or without fracture of the bone, a guillotine amputation under scopolamine-morphine and gas anaesthesia is indicated. It has been the experience of one of us (G. G. D.)

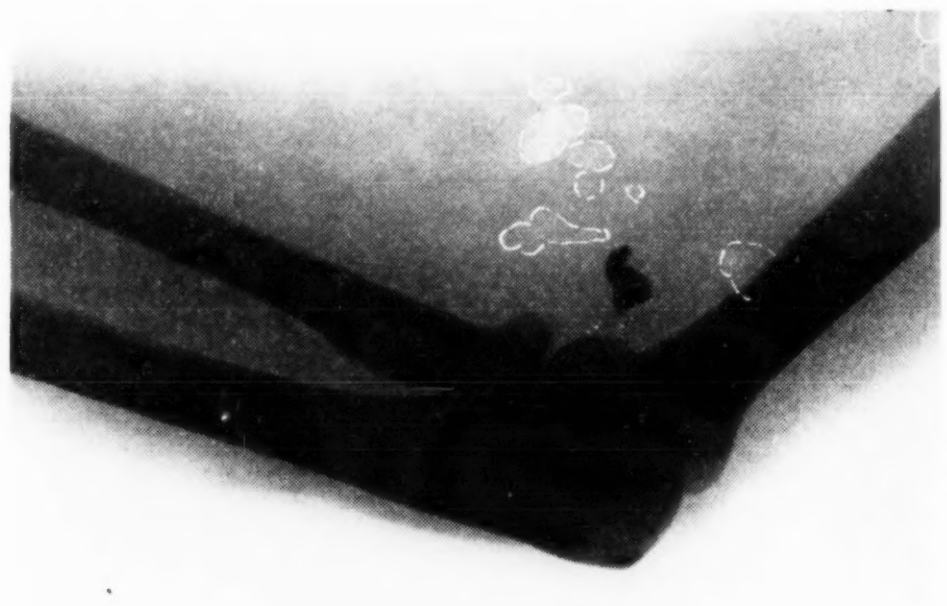


Fig. 9. A number of halo-like areas about a foreign body denoting a local or staphylococcus-like type of gas bacillus infection. Local surgical measures as debridement, incision, excision, etc., with drainage are indicated

that ether anaesthesia has a deleterious effect upon the operative course of these patients. The exact nature of this is hard to determine, but the ether effect appears to be synergistic with the desseminated toxins of the infected organisms. Therefore, we advise amputation of the guillotine type, high above the level of the spreading infection which can be readily ascertained by the use of the Roentgen ray as pointed out by Davis[10] in 1916. When the Roentgen ray picture shows the gas formation in single or isolated halo-like areas or about a foreign body which might be compared to

a local staphylococcus-like type of abscess in extent, local surgical procedures as debridement, incision, excision, etc. with drainage are indicated. (See Figs. 1 to 6 and 9). When the Roentgen ray picture shows the gas as an extensive honeycombing generalized, streptococcus-like in extent involvement, a guillotine amputation is indicated. (See Figs. 10 and 11). Secondary prosthesis may be done at a later date when all signs of infection disappear and the patient is entirely recovered from the effects of the toxemia and surgery. Blood transfusions are indicated at times and should be carried on as frequently as post-operative conditions will permit. The viable stump should be carefully preserved and guarded against secondary trauma since it has been shown that recurrences of the gas bacillus infections may occur after surgery.

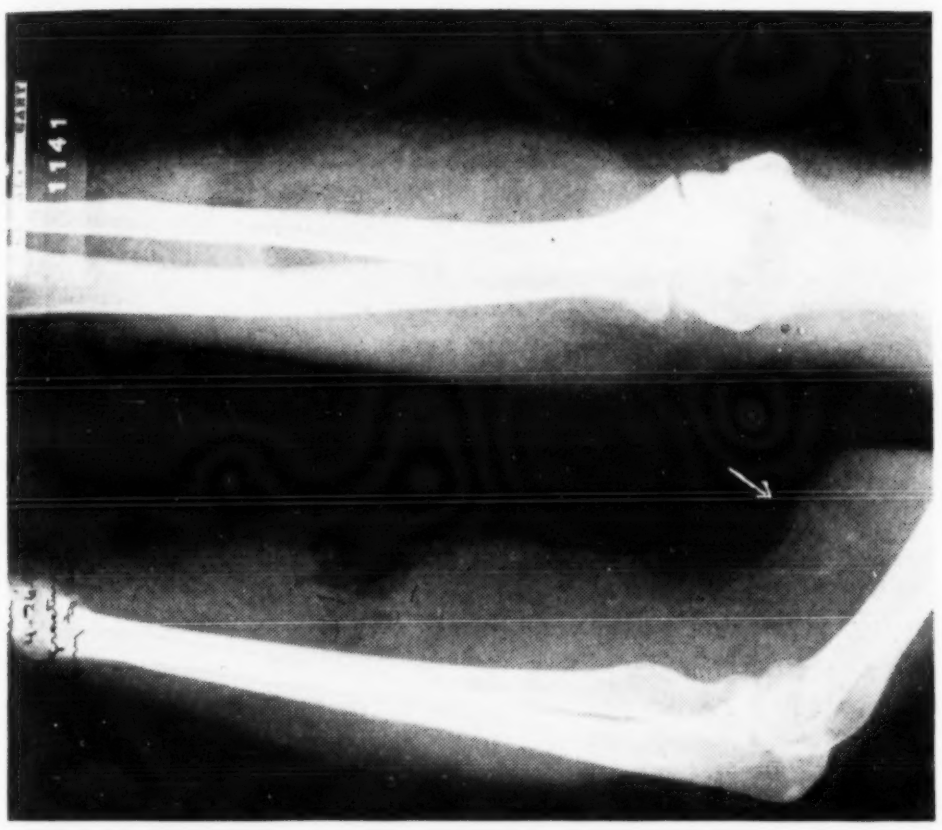


Fig. 10. Gas bacillus infection resulting from a grinding, crushing trauma. The arm was pulled in between two rollers, causing avulsion of the skin and injury to the muscles of the forearm. The honeycomb like picture is noted from the wrist to the elbow. This gas bacillus is more streptococcus-like in its distribution, and guillotine amputation is indicated

2. Where there is not much destruction of the tissues due to the injury conservative surgical measures are indicated. Numerous methods of therapy have been advocated and we feel that too much stress cannot be placed upon the free incision of the wound along the fascial planes and nerve sheaths, followed by the continuous irrigation of the wound with hydrogen peroxide, potassium permanganate 1-500, or Dakin solution. Fidean-Green[24] advocates the use of oxygen gas in the form of a continuous irrigation. Physiologically this method is very logical.

X-Ray Treatment of Gas Bacillus Infections

RECENTLY Kelly,[25] and Faust,[26,27] have reported the successful use of x-ray irradiation in the treatment of gas gangrene. Faust states that "there are several possible theories in the action of the x-rays but as yet no one knows the exact mechanism. But since the results obtained were favorable it is believed the methods of therapy should be given publicity for the good that it may do. One explanation of the action of the x-ray is that when x-rays are played upon nutrient fluids they are deadly to protozoa by producing small quantities of hydrogen peroxide; the presence of hydrogen peroxide would be fatal therefore to the B. welchii and other anaerobic organisms. Due to the absorption of the hydrogen peroxide the x-ray treatments need to be frequent in order to produce more of the gas.

"Another theory of the action of the x-ray is that it causes the tissue to throw out a protein which may be resistant to the toxin of the gas gangrene organisms. The x-ray may act as a catalytic agent by aiding the serum to act on the toxin in those cases in which the antitoxin therapy is given.

"TECHNIQUE: The technic of the x-ray treatment is 88 kilovolts peak, 5 milliamperes, 40 centimeters distance from target to skin, with 0.5 millemeter of aluminum as a filter for three minutes, over each area. This single treatment gives 45 'r' units. This therapy is such that it may be given with most portable machines and hence may be available in many institutions where radiographic work is ordinarily done. When using a fine focus radiator tube the treatment is given for 30 seconds to allow the tube to cool and not overheat it. Thus the treatment is resumed with intermissions until six exposures of 30 seconds each are made and thus the three minutes of time are attained without damage to the equipment."

Fig. 11. A generalized or streptococcus-like gas bacillus infection giving a honeycomb picture calls for a guillotine amputation. The Roentgen-ray is further helpful to the surgeon in coming to a conclusion as to the site of amputation (note arrow)

Therefore, it would seem that early prophylactic treatment intensively administered would be the easiest way of combating these gas bacillus infections. But once the infection has set in, the heroic administration of the specific antitoxin plus the indicated surgical procedures is the treatment of choice, and the recent use of x-ray irradiation has added to our armamentarium to combat the morbid processes set up by the gas gangrene group of organisms.

In wounds about the anus and buttocks[30] tetanus and gas bacilli infections are a potential menace, and as a prophylactic measure, a colostomy, preferably in the splenic flexure should be performed. We have observed both tetanus and gas infections as complications of wounds about the anus and buttocks. The infection is induced by fecal contamination.

The use of ether in gas bacillus infection has been a tragedy. In two definite cases even before

the operation was started the patient died. That was 20 years ago. Since that time we have not used ether in gas bacillus infections when operating. It is found that the use of scopolamine and morphine with nitrous oxid gas when sawing through the bone has removed this complication of mortality in anaesthesia.

In conclusion, we feel that it might be of great value to the profession if surgeons encountering cases of death at operation from ether anaesthea would report these deaths, preferably to the writers.

Bibliography:

1. Reeves, J. R.: Infections by Gas Forming Anaerobic Bacilli; Analysis. *J.A.M.A.*, 104: 526-529, February 16 1935.

2 and 3. Park, W. H. and Williams, A. W.: Pathogenic Microorganisms, 10th Edition, 584-586, Lea & Febiger, Philadelphia, 1933.

4. Bullock, W. E. and Cramer, W.: *Proc. Roy. Soc. London,* 1919 (s.B) 90: 513.

5. Barney, Edna L. and Heller, Hilda H.: A Detailed Study of a Case of Gas Gangrene Following a Compound Fracture; Studies on Pathogenic Anaerobes 3. *Arch. Surg.,* 4, No. 2, 470-484, March, 1922.

6. Weinberg, M.: *Proc. Roy. Soc. London,* 1915-16, 9: 121.

7. Bull, C. G. and Pritchett, I. W.: *J. Exper. Med.,* 26: 867, 1917.

8. Glenny, A. T. and others: Multiple Toxins Produced by Organisms of Clostridium Welchii Group. *J. Path. & Bact.,* 37: 53-74, July, 1933.

9. Emrys-Roberts, E. and Cowell, E. M.: Gas Gangrene of Muscle, with Special Reference to its Morbid Anatomy, and Histology. *J. Path. & Bact.,* Cambridge, Vol. 21, 473-490, October, 1917.

10. Davis, Geo. G.: Roentgen-Ray Diagnosis of Gas and Pus Infections as Complications of Wounds with Deeply Buried Bullets or Shell Fragments. *Surg., Gynec. & Obst.,* Vol. XXII, June, 1916, No. 6.

11. Sprague, F. A.: Gas Gangrene Due to B. Welchii Diagnosed, Roentgenologically. *Am. J. Roentgenol.,* 6: 145, March, 1919.

12. Schneider, J.: Importance of Roentgenography in Diagnosis and Therapy of Gangrene of Forearm; Case. *Roentgenpraxis,* 6: 522-524 August, 1934.

13. Glotowa, E. W., Ostrowski, O. A., and Ssilanowa, I. W. *Zentralbl. f. Bakt. (Abt.),* 133: 415-419, March, 1935.

14. Pellegrini, A.: Anti Anaerobic Serum, Prophylaxis, and Therapy. *Reforma Med.,* 51: 550-559, April, 1935.

15. Melnikov, A. M.: Clinical Aspects of Gas Bacillus Infections. *Vestnik, Chir.,* 38: 3-26, 1935.

16. Grantham, S. A.: Clinical Study of Welch Bacillus. *J. Missouri M. A.,* 32: 273-275, July, 1935.

17. Warthen, H. J.: Gas Bacillus Infections, Incidence Treatment and Mortality. *Virginia M. Monthly,* 62: 276-280, August, 1935.

18. Ghormley, R. K.: Gas Gangrene and Gas Infections. *J. Bone & Joint Surg.,* 17: 907-915, October, 1935.

19. Eliot, E. Jr. and Easton, E. R.: Gas Gangrene, Review of Seventeen Cases. *Ann. Surg.,* 101: 1303-1405, June, 1935.

20. De Takats, Geza: Gangrene. *Surg. Clin. N. A.,* Vol. 16, 317-336, February, 1936.

21. Lohr, W.: Present Status of Research on Serum Treatment. *Beitr. z. klin. Chir.,* 158: 569-589, 1933.

22. Angerer, H.: Question of Serum Administration in Gas Edema. *Arch. f. klin. Chir.,* 178: 179-191, 1933.

23. Ovechko, I. F.: Serotheraphy. *Sovet. vrach. gaz.,* 1068-1068, November 30, 1933.

24. Fidean-Green, W. B.: Gas Gangrene of Thigh and Buttocks: Case Treated by Oxygen Irrigation. *Lancet,* 2: 1280, December, 1934.

25. Kelly, James F.: The X-ray as an Aid in the Treatment of Gas Gangrene. *Radiology,* 20: 296-304, April, 1933.

26. Faust, J. J.: Report of X-Ray Treatments in Gas Gangrene Cases. *Radiology,* 22: 105-106, 1934.

27. Faust, J. J.: Radiation Therapy of Gas Bacillus Infection. *Illinois M. J.,* 66: 547-551, 1934.

28. Hanchett, McMicken: Gas Bacillus Infection, *Trans. Western Surg. Assoc.,* 1934, 143-161.

29. Millar, W. M.: Gas Gangrene. *Surg., Gynec. & Obst.,* 54: 232-238 (February), 1932.

30. Davis, Geo. G.: Wounds of the Buttocks in War. *J.A.M.A.,* 1917, p. 1689-1692.

Abdominal Injuries

By Owen H. Wangensteen, M.D., F.A.C.S.,
Department of Surgery,
University of Minnesota
Medical School

THE abdomen is the largest cavity of the body and contains the organs dealing with alimentation and excretion, the adrenal glands which furnish the drive for our daily tasks, and, in the female, the genital organs. These abdominal viscera may be injured in a large number of ways. In the main, one might say there are two types of injury: wounds sustained as the result of blunt force and pentrating wounds, such as bullet and stab, or wounds made by any puncturing type of instrument. The intestines occupy a large portion of the abdominal cavity, so it is not surprising that intestinal injuries of one sort or another represent a large percentage of injuries to the abdomen. In injuries of the upper abdomen the spleen is not infrequently injured. Injuries of the kidney are one of the most common sequences of blunt trauma to the abdomen. Injuries of the bladder are also rather frequent. About half of them are associated with fractures of the pelvis and the other half attend injuries of the lower abdominal wall. The contents of the abdomen are protected in some measure by the abdominal muscles which overlay and envelop them. Injuries of the abdominal viscera are obviously much more common in men than in women, due largely to occupational hazards. Granted, however, the same trauma in women with lesser abdominal musculature frequently weakened by childbearing, the same force will usually produce more serious damage.

When violence strikes the abdomen, it is usually the viscus which is immediately beneath the site of the blow which is injured. The state of digestion with reference to whether the stomach and intestine are empty or full is an important determinant in the occurrence of injury to the gastrointestinal canal. A distended intestine whose wall is thin is much more likely to be damaged than an empty, contracted bowel. When the bowel is fixed as at the duodeno-jejunal angle and the terminal ileum, it is most susceptible of injury. Occasionally, however, the viscera directly beneath the point of trauma escape injury and the force of the blow is carried over to some other portion of the abdomen and expends itself upon a viscus less able to withstand the compression and disrupting effects of trauma. The liver is commonly injured by a crushing blow received in the upper abdomen. When the capsule of the liver is broken the hepatic tissue offers slight resistance to fracture. Fractures of the right lobe of the liver are about eight times more frequent than injury of the smaller left lobe. The spleen being a vascular organ fractures readily; when important vessels are torn the blood loss may be severe. Delayed hemorrhage attending splenic injury may sometimes come on a week or even a month later, and frequently presents a complication more dangerous than the original injury. Isolated injury of the mesenteric or omental vessels may occur or may accompany any of the injuries already mentioned.

Isolated injury of the pancreas is quite unusual, and in my experience has been limited to one case. The patient, a boy in his late teens, was kicked over the epigastrium by a horse. The condition was not

diagnosed until operation, at which time fat necroses were observed in the peritoneal cavity. The pancreas was found to be divided over the spine much as if it had been cut with a knife. The capsule of the pancreas was carefully resutured and drains were led down to the site of division. The boy died about a week later, and at autopsy the force which ruptured the pancreas was also found to have thrombosed the veins of the retroperitoneal duodenum.

Any of the large blood vessels traversing the abdomen such as the aorta, the inferior vena cava or the iliac vessels, as well as the vessels which supply the abdominal viscera, may be injured in either blunt or penetrating types of trauma.

Recognition of Abdominal Injury

I SHOULD like to preface my remarks relating to the treatment of abdominal injuries by digressing for a moment to speak of the criteria one employs in the recognition of abdominal disorders in general, and to refer in particular to the criteria which may be used in the recognition of various abdominal injuries. Many of us find it difficult to arrive at an exact diagnosis of an abdominal tumor. In such an event, I am apt to say to the patient that he would have difficulty differentiating an orange from an apple if one were to put either beneath six or eight bed-covers. Unless he felt the corrugations of the orange or the stem of the apple, a guess would only be 50% accurate. When one sees an actual abdominal lesion one employs largely the means used in making any clinical judgment. I find it helpful to ask myself the question, what is the nature of the functional disturbance? The patient with an acute abdominal lesion may or may not vomit, but he is usually complaining of abdominal pain. The significance of the functional disturbance is not apparent in the immediate great disability suffered by a patient with a perforated ulcer of the stomach or duodenum, as contrasted with the rather gradual development of incapacity observed in patients with appendicitis. It is always wise to inquire freely into the manner in which the symptoms developed. After having determined the nature of the functional disturbance present, one should ask himself what is the anatomy of the lesion present. The physical findings interpreted in the light of the functional disturbance furnish the best clue as to the probable nature of the anatomical lesion.

It is always well to inspect the abdomen carefully. In large swellings of the abdomen, inspection frequently gives the best information. I recall seeing a patient a number of years ago, when I was a junior house officer on a hospital service, whose story attests the significance of inspection. The patient had been observed by many competent medical consultants and had been sent to the operating room with the diagnosis of ascites to be tapped by the surgeon. The surgeon who saw the patient for the first time while she lay on the litter said: "Gentlemen, that is not ascites." That surgeon knew that a patient with ascites has a broad abdomen, and a patient with a large solid tumor or an ovarian cyst has a protuberant abdomen. Since this incident came under my observation I like to show junior medical students the great contrast afforded in the broad abdomen of the ascitic patient from the medical wards and that of a woman from the obstetrical wards about to be delivered of her first baby. Inspection is of importance also in differentiating a swelling which is intraperitoneal from one which is retroperitoneal or in the abdominal wall. I need only to refer to the excursion of the diaphragm; when a movable tumor in the upper abdomen is intraperitoneal it will go through a wider range of excursion than when the swelling is retroperitoneal. Lesions in the abdominal wall itself occur with sufficient frequency so that one should bear them in mind. If one will have the patient blow with the nose held pinched, a tumor or swelling in the abdominal wall comes up very prominently, while the one within the peritoneal cavity will disappear from view as well as from the examining hand, due to the contraction of the muscles over it.

In acute abdominal lesions, inspection is not so valuable but it does serve to indicate whether the diaphragmatic component of respiration is ablated. The most valuable criterion in determining the anatomy of the lesion in acute abdominal disorders is palpation. When one examines a patient, he should do so with the patient relaxed as much as possible, with the eyes closed and the mouth open. The rigidity of the abdominal muscles in acute abdominal disease or injury is in fact a measure of the degree to which the parietal peritoneum has been irritated. The more severe the irritant the greater will be the contraction of the abdominal muscles. The most severe irritant which can affect the parietal peritoneum is afforded in the escape of the content of the stomach or duodenum after perforation of an ulcer or following injury. In these conditions one finds the most rigid abdomens observed clinically. Perforation of the colon, though even more hazardous for the patient, does not cause him as much pain and immediate disability, for the contents are not so irritating. Of all the serous surfaces in the body, the parietal peritoneum appears to be the most sensitive, much more so than the pericardium, the pleura, or the meninges. Those of you who may look upon this remark with some skepticism may well recall the lack of distress observed in a patient given pneumothorax as contrasted with the rather anxious appearance of the face of the patient into whose peritoneal cavity air or other gas is placed for diagnostic purposes. Several years ago Armitage Whitman[24] had his own peritoneal cavity inflated with air to demonstrate more effectively to his confreres, who, he felt, used this procedure more than was justified, the incapacity which it caused. He then described his experience with this procedure, which account must have helped to stop the practice of employing pneumoperitoneum as an ambulatory diagnostic test. Because of the pain suffered in the erect posture he found it more comfortable to walk on his hands and knees or to stand on his head so the air would gravitate up against the less sensitive pelvic peritoneum. The diaphragmatic peritoneum is the most sensitive portion of the parietal peritoneum. Today, when inflating gas into the peritoneal cavity for diagnostic purposes, we employ carbon dioxide which is very quickly absorbed — usually within 45 minutes. Occasionally oxygen is used, which gas takes usually about four days for complete absorption. The absorption of air takes usually two to three weeks, hence its efficacy in keeping a lung compressed in pneumothorax.

The escape of any substance, therefore, into the peritoneal cavity will usually cause distress, and the abdominal muscles will respond by reflex con-

traction in proportion to the degree to which the parietal peritoneum has been irritated. Juices from the upper reaches of the bowel and stomach, viz., a mixture of gastric juice, bile, pancreatic juice and succus extericus, will prove most irritating and in consequence will give the most rigid abdomens. Lesser rigidity of the abdominal wall is observed when fluid escapes into the peritoneal cavity attending pancreatic necrosis; pus, blood and urine cause corresponding lesser contractions of the abdominal wall, and clinical conditions in which these substances are found in the peritoneal cavity, in the main, are characterized by rigidity of the abdominal wall corresponding in degree to the nature of the irritant which has found its way into the peritoneal cavity.

In deciding upon the anatomy of the lesion present it is important to examine the patient in a position of repose, in so far as this attitude can be attained in an ill patient. If the examining hand is pressed gently into the abdominal wall at varying places and no tenderness or rigidity or spasm of the abdominal muscles is encountered, one should not conclude that the parietal peritoneum is not being irritated until he can satisfy himself that quick release of the hand, repeated at various places *(choc en retour)*, causes no distress. A substance like urine escaping into the peritoneal cavity, while potentially serious to life, frequently does not irritate the parietal peritoneum in the manner which we are accustomed to see in purulent peritoneal exudations. Nevertheless, peritoneal irritation can usually be demonstrated in such instances by the maneuver just described.

The sign of most localizing value in acute abdominal disorders or injury is the site of greatest tenderness or muscle rigidity. For instance, when a patient has acute abdominal pain and we find the greatest tenderness beneath the right costal margin we may usually rightfully conclude that the difficulty is with the gall bladder. It is to be borne in mind, however, that lesions of the spinal cord or posterior root ganglia, as well as thoracic disease, may give rise to abdominal rigidity. In differentiating a pleuritis which may cause rigidity of the upper abdominal region, careful examination of the chest, rectal examination, and a careful integration of all the symptoms and findings, usually suffice to avoid error. In lesions or injuries of the spine and spinal cord, rigidity without tenderness is the more frequent occurrence.

With reference to the importance of percussion, it is to be remembered that the entire abdomen would be as dull on percussion as the liver or the deltoid muscle, were it not for the pressure of gas in the bowel. An area of unusual dullness attending abdominal injury suggests the collection of blood in the peritoneal cavity. Percussion will detect the absence or presence of gaseous distention of the bowel as a whole, but is not to be relied upon to tell just what segments of the bowel are distended. Similarly the presence of gas in the peritoneal cavity is much more accurately determined by x-ray examination. In abdominal swellings, the demonstration of shifting or fixed areas of dullness helps considerably in determining whether ascites or encysted fluid such as a large ovarian cyst is present.

Auscultation of the abdomen is far too much neglected. In acute disorders, it will serve to tell whether or not *intestinal colic* which characterizes bowel obstruction is present or absent, that is, audition of borborgymi with the stethoscope at the acme of the pain of which the patient complains. This simple test usually suffices to rule in or out the consideration of bowel obstruction. Similarly, when distention is great and fluid separates intestinal coils, the heart sounds and even the breath sounds may be heard over the patient's lower abdomen. Such a finding in the absence of intestinal colic usually denotes peritonitis. The rationale is that fluid is a good transmitter of sound.

These considerations of physical examination which have just been discussed are the criteria upon which one strives to determine in abdominal trauma the value of the injury. In abdominal injury, as in acute disorders of the abdomen, x-ray evidence with reference to the absence or presence of free gas in the peritoneal cavity is also most important. In instances of blunt trauma to the abdomen, this consideration may be the chief determinant in deciding whether operation is necessary. If the patient is not too ill, he should be examined in the sitting or standing posture—the exposure to the x-ray film being made in the erect posture. If he is very ill the film should be made in the lateral position with the right side up. A very small quantity of gas (4 to 20 cc.) almost invariably can be made out beneath the diaphragm with the patient in the erect posture. It probably takes a somewhat larger amount to be visualized beneath the abdominal wall over the liver in the lateral posture. These examinations are infinitely more delicate than the detection by percussion of the obliteration of liver dullness. X-ray examination of the abdomen with the patient lying supine will indicate whether there is any distention of the intestinal canal. It is to be remembered that the diameter of the intestinal coils observed in the x-ray film with the patient in this position is about one-third greater in size than that determined by actual measurement because of the divergence of the rays with the abdomen so near the tube. The x-ray film taken in this position also gives valuable information about another point, viz., rupture of the retroperitoneal duodenum and retroperitoneal portions of the colon. In the event of tears of the retroperitoneal duodenum, gas escapes about the kidney and can be easily visualized and the probable nature of the injury identified—as an experience in our clinic demonstrated some two years ago.[20]

The pulse is usually not much altered in abdominal injury unless there has been considerable hemorrhage. Though a patient may be profoundly prostrated, attending perforation of the upper reaches of the intestinal canal (because of the severe nature of the irritant spilled into the peritoneal cavity), the pulse and blood pressure usually exhibit quite normal values. The temperature and leucocyte count rarely give any information of value early. In perforation, the leucocyte count and temperature are usually normal early, whereas in hemorrhage there are frequently slight rises —finding, however, of no diagnostic or prognostic significance.

When one has clarified the value of the functional disturbance, and determined in so far as possible the anatomy of the lesion, one is in a position to give a fairly satisfactory answer to the final and most important query, viz., what is the probable pathological nature of the lesion present? One must bear in mind that abdomen means "hidden" and that practically all our important deductions

are based largely on indirect evidence—yet, it is surprising with what accuracy the greater number of lesions may be identified. In acute disorders and in injury it is important to decide largely whether operation is in order. The conclusion as to what type of lesion is present is the most significant item in deciding whether operation should be done. It need scarcely be said, therefore, that acute abdominal disease or injury is not synonymous with operation. "Acute abdomen" no longer means "operate". Operation is in order where certain conditions indicate and demand it or where the presence of a potentially serious lesion cannot be satisfactorily excluded.

What Viscera is Injured?

THE scope of this presentation does not warrant going into any detail concerning the identification of the particular type of injury present. The general considerations discussed above, when integrated in the light of where the trauma was inflicted upon the abdomen, the nature of the trauma, the functional disturbance, the physical findings and the two x-ray observations mentioned, viz., a "scout" film and one in the erect posture, serve to afford quite satisfactory orientation concerning the probable pathological nature of the injury.

In my experience liver injury has not been associated with bradycardia as described by Finsterer.[6] Tenderness and normal dullness on percussion over the usual course of the ascending colon in injuries of the liver and over the descending colon in splenic injury are usual. Frequently an intraperitoneal hematoma may be palpated or identified by percussion. Kidney injuries may be identified by the presence of blood in the urine, and if the local bleeding is great, by the palpation of a mass which may be felt both by a palpating band in the loin as well as beneath the anterior abdominal wall. Bladder injuries are to be recognized in the difficulty of passing urine, the appearance of blood in the urine or failure to recover fluid injected into the bladder. Intravenous urograms may be of value, as may be the injection of an opaque medium (silver iodide) into the bladder in the recognition of kidney and bladder injury. It is to be remembered that, following the passage of a catheter into the bladder when intraperitoneal rupture is present, air may make its way into the peritoneal cavity and be visualized beneath the diaphragm on the film in the erect posture. Perforations of stomach and intestinal canal are to be recognized in the presence of *free gas* below the diaphragm. The only perforation over which I have some reservations concerns a tear in the small intestine. Gas is usually present in sufficient quantity in both the stomach and colon to cause it to accumulate beneath the diaphragm in sufficient amount to be recognized when a complete tear or perforation of the wall of the stomach or colon is present. Gas usually can not be visualized in the small intestine normally, and, unless the bowel is distended, it may take some considerable period of time for sufficient gas to escape, following perforation of the small intestine, to cause a collection large enough to be seen beneath the diaphragm. Because of the pneumoperitoneum which attends opening of the abdomen in the experimental animal, it is not a question which lends itself easily to experimental inquiry, and the answer will probably have to come from carefully made clinical observations. As yet I have not come to grief in treating patients with abdominal injury conservatively when free gas has not been demonstrated, yet the possibility of perforation of the small intestine not attended by pneumoperitoneum has frequently been in my mind. In response to an inquiry, Dr. Harry Singer,[17] of the Medical Staff of the Cook County Hospital, has written me that a few instances of isolated rupture of the small intestine by blunt trauma to the abdominal wall have come to his attention without the occurrence of pneumoperitoneum.

The Treatment of Abdominal Injuries

AS MAY have been inferred from what already has been said, the important matter to decide is whether operation is in order, or whether the patient should be treated conservatively. In perforating injuries, whether by a bullet, stab or other perforating object, operative intervention is almost invariably to be done as quickly as conveniently can be done, for in the majority of instances, a segment of the manifold twists and loops of the gastrointestinal canal is likely to be perforated; and, as is apparent, the time factor is very significant in determining the outcome. The sooner the perforation is closed by suture the better. As long ago as 1884, Dr.C.T.Parkes,[13] of this city, showed by shooting into the peritoneal cavities of dogs that spillage occurred almost invariably directly upon the infliction of the wound, and perforation of the small intestine was usually present. The lower in the intestinal canal the perforation, the greater is the risk to the patient. Perforation of the stomach is least hazardous, and especially when the stomach is empty. Elsewhere, I have indicated that the stomach may be perforated without closure of an incision one centimeter in length in the dog, cat, rabbit or guinea pig when the stomach is empty, without mortality;[20] whereas when food is present in the stomach at the time of perforation, the mortality was 88%.

When George Makins[9] returned from the Boer war he wrote a monograph, in 1901, advising the conservative treatment of perforating wounds of the abdomen. It is to be recalled, however, that a type of itinerant warfare was pursued there which did not permit of the establishment of bases at which emergency operations could be well done. Similarly, Nicholas Senn,[15] in writing of his experience in the siege of Santiago in the Spanish-American War, came to a conclusion similar to Makins'. Be it ever said, therefore, to the great credit of American surgery, that when President McKinley was shot through the upper abdomen at Buffalo at the Pan-American Exposition in September, 1901, the surgeons in charge operated immediately and closed the perforation in the anterior and posterior walls of the stomach. The outcome was unfortunate, but even today a similar outcome might have followed the extensive damage done by the bullet in the retroperitoneal space. Numerous recent reports attest the hazard of such penetrating injury in the retroperitoneal tissue.[14] Following the shooting of President Garfield in 1881, Marion Sims[16] was prompted to write a dissertation upon bullet wounds of the abdomen in which he advocated early operative intervention. In his prediction that with early operative closure intestinal perforation would no longer be very hazardous, he did not reckon adequately with the bacterial content of the bowel. Cushing and Livingood[3] and Kendall[7], in epoch-making papers, have well pointed out the

dangers of peritoneal contamination with intestinal content. Until we come upon some pharmacological or immunological means of dealing adequately with the menace of escape of intestinal content, the mortality will probably continue to be lamentably high. Even as late as the beginning of the World War, we find well recognized surgeons on both sides engaged in the conflict advocating conservative treatment of perforating gun shot wounds of the abdomen.[8] Let any one who still doubts the validity of operation read the illuminating report by Enderlen and Sauerbruch[5] in which the superiority of the immediate operative attack is unequivocally shown. Closure of perforations, on the whole, is a much safer policy than intestinal resection. A bullet or stab wound which obviously has gone only into or through the liver alone very rarely demands operation.

When dealing with injuries in which the gastro-intestinal canal is not perforated, the need for operation is not so urgent. To be certain, a torn bladder should be sutured as quickly as possible. Experience has demonstrated, however, that a damaged kidney may be managed conservatively with greater safety to the patient than by operation, unless the bleeding is so severe as to demand operative intervention, in which event the risk also is great. This experience with the treatment of renal injuries has suggested a trial of the same means in dealing with tears of the liver and the spleen, until today, at the University of Minnesota Hospital from where I come, we operate arbitrarily only in perforating types of injury. In subcutaneous types of injury, we permit ourselves to be guided largely by whether or not perforation of the gastro-intestinal canal can be demonstrated in the presence of free gas outside of its lumen. In fracture of the liver or spleen we rarely operate and almost invariably treat the patient expectantly, keeping close watch on the blood pressure and pulse rate. In instances of subcutaneous injury, where it is felt that the probable injury is that of liver or spleen, the appearance of tender areas remote from the site of injury should be looked upon with suspicion. In the main, operation should be done in all such instances, for a tear in the mesentery or a perforation of the small bowel may be present. Experience with the non-operative treatment of bullet wounds of the lung also lends support to the practice of dealing conservatively with bleeding from intraperitoneal solid viscera. Many surgeons engaged in the World War had an opportunity to satisfy themselves that the conservative plan, on the whole, was safest in such instances.

To be certain, in a State University Hospital which draws its injured from varying portions of a large territory, the instances in which the intraperitoneal hemorrhage accompanying abdominal injury has been great have probably been largely eliminated. Some have died on the spot where the injury was received from a tear of important blood vessels, such as mesenteric vessels, portal vein, or the vena cava, or even the aorta or some of its branches. In the obviously ill patients with complex types of injury, including concomitant chest and head wounds or serious injury of the extremities, in the presence of concurrent suspected fractures of spleen and liver, we have found it wise to treat such patients conservatively. These observations have made it appear even more rational to treat isolated injuries of spleen or liver conservatively, unless a falling blood pressure denoted the continuance of loss of blood. When operative intervention is undertaken for the control of such hemorrhage, the importance of adequate transfusion of blood both before and during the operation can not be stressed too much. It should be remembered that blood loss which causes shock is probably in the neighborhood of 1000 cubic centimeters of blood in an average sized adult.

I have once employed five Group 4 donors, giving a patient who had numerous congenital arteriovenous communications with a hemangioma-like condition of the tissues in the neighborhood of the hip joint, 2700 cubic centimeters of blood through the veins of three extremities within the space of less than an hour, during an attempt at disarticulation. The bleeding seemed scarcely controllable with all known means at our command—yet with adequate replacement of a severe blood loss by efficient house officers and operating room personnel, the bleeding was stopped, the operation was continued with equanimity, and the patient made a satisfactory recovery. Because the pulse continued somewhat rapid, two additional transfusions were given shortly after the operation, so that within the space of a few hours this patient was given about 4000 cubic centimeters of blood from seven different Group 4 donors. Other less exciting circumstances have also taught me the importance of replacing blood loss adequately. To feel that one's responsibility has been adequately discharged with the giving of a single transfusion in severe blood loss is mere hypocrisy and affords no solace to a knowing surgical conscience.

There will by no means be uniform agreement among surgeons over the plan of conservative treatment of abdominal injuries in the absence of perforation of the gastro-intestinal canal, but I can only say from my own experience that, in the main, I believe that tears of the solid viscera are better treated conservatively than by operation; and when medical men generally begin to advocate what they have learned from their own critical observations and experience, and cease to exhibit an anxiety to find themselves in common agreement with what recognized authorities say, the frequently repeated ancient errors will drop out of our textbooks.

As one examines the literature, he can not escape the impression that a more and more conservative attitude is becoming increasingly prevalent among surgeons generally, in dealing with injuries of solid intraperitoneal viscera. The chief difficulty which hedges about the problem concerns largely being certain of the exact nature of the injury. There is, admittedly, opportunity for being wrong — yet the price of satisfying one's curiosity by operation is too frequently bought at too big a premium, with an increased mortality. It is well enough to say that abdominal exploration may be carried out in the chronic abdominal disorder without risk, but unfortunately exploration is not so innocuous in the presence of abdominal hemorrhage, which is being spontaneously controlled. With the opening of the peritoneal cavity in such instances, I have seen startling acceleration of the bleeding which, if not readily controlled or the blood loss quickly made up, might have ended disastrously.

Our practice with fracture of solid intraperitoneal viscera attended by hemorrhage, in which a normal blood pressure is sustained has been to

keep the patient quiet, apply heat to the abdomen in the form of massive hot packs, and to employ continuous suction applied to an inlying duodenal tube prophylactically to prevent distension or to combat existing intestinal distension. In the type of case which comes under my observation at the hospital, we find that the bleeding usually stops. If the pulse continues rapid despite a fairly normal value for the blood pressure, a steep Trendelenburg posture on a shock-frame which permits of elevating sharply the foot of the bed, and transfusion of blood, are employed. Our nurses on the surgical service have schooled themselves in the importance of determining the blood pressure and whenever the pulse continues at a rate faster than 100 beats per minute, they check the blood pressure as frequently as they count the pulse. A continued fast pulse with a falling blood pressure despite the employment of these expedients connotes continued bleeding which demands operative intervention.

The conservative treatment of subcutaneous abdominal injuries in which free gas is not present in the peritoneal cavity must envisage the occurrence of such injuries as rupture of the gall bladder with the spillage of bile as well as pancreatic injury. Fortunately, however, these are very unusual, and it so happens that most patients with severance of the common bile duct or injury of the gall bladder, in which a good deal of bile escapes into the peritoneum (apparently a rare occurrence in rupture of the gall bladder) survive for several weeks and exhibit large collections of bile, the absorption of which gives rise to jaundice which permits of its recognition—indicating at the same time the necessity for operation.[19] From observations relating to trauma of the pancreas on experimental animals, I have the impression that it is a matter of no great concern whether operation is done or not. Moreover, as far as pancreatic necrosis is concerned, I have the distinct feeling that the non-operative course is safer for the patient.[21] Pancreatic apoplexies characterized by shock and severe blood loss need operative intervention to stop the bleeding, but unfortunately there is no promise that this measure will stop the auto-digestion of the pancreas which serves to continue the disorder. Starvation and suction applied to an inlying duodenal tube, for the ordinary case of pancreatic injury or pancreatic necrosis, I believe offer as much as operative intervention.

The type of injury which can not fail to cause worry in the conservative management of subcutaneous injury is fear lest the mesentery of a loop of bowel be torn. Persistent points of tenderness toward the mid-line with increasing distention may suggest such an occurrence. It is important in conservative treatment to resurvey the situation several times a day in the beginning, and after the lapse of 48 hours, at least twice a day noting the presence or absence of swellings, tenderness, masses and the like. Just as such an examination includes a consideration of the patient's status with reference to his pulse, temperature, and respirations, similarly it also presupposes frequent auscultation of the abdomen to note the manner of behavior of intestinal contractions. In the occurrence of intestinal distention as indicated by percussion, it is important to have a "scout" film made, about once in every 24 hours, to determine the pattern of distention present, until the patient is obviously out of danger.

Summary

THERE are essentially two types of abdominal injury, viz., subcutaneous and penetrating. The latter group almost invariably needs immediate operation because of the great likelihood that a hollow viscus is perforated. Following subcutaneous trauma, the indication for operation should be determined largely by the demonstration of *free* gas outside the lumen of the gastro-intestinal canal by the x-ray examination above described. Hemorrhage consequent upon blunt trauma to the abdomen, whether occurring in the neighborhood of the kidney or from an intraperitoneal source, in the main, is better treated without operation when a normal blood pressure value can be sustained by the employment of conservative means. Every abdominal injury does not mean immediate operation. The necessity for operative intervention should be supported by adequate indication, either in the presence of perforation of a hollow viscus, the continuance of bleeding, or the probable existence of a lesion which will ultimately demand surgery.

"Acute abdomen" is not synonymous with operation. Surgeons must critically examine themselves to be certain that they are not being deceived when they arrogate credit to themselves for successful issues attending operative intervention and ascribing the cause of death to the nature of the malady when operation fails. As Ambrose Paré taught us, the surgeon can in most instances claim little credit for the healing of a wound. In his words, we can better say: "I treated him but God healed him." A stricter following of the Biblical admonition to "Render therefore unto Caesar the things which be Caesar's and unto God the things which be God's", will help us in not being misled by the testimony of false prophets.

Bibliography:

1. Bohler: Darmschusz mit sechs Perforationen nach funf Tagen operiert und geheilt. *Med Klin.*, 13:Pt.2:790, 1917.

2. Counsellor, V. S. and McCormack C. J.; Subcutaneous perforation of the jejunum. *Ann. Surg.*, 102-365, 1935.

3. Cushing, H. and Livingood, L. E.: Experimental and surgical notes upon the bacteriology of the upper portion of the alimentary canal, with observations on the establishment there of an amicrobic state as a preliminary to operative procedures on the stomach and small intestine. Johns Hopkins Hospital Repts., 9:543, 1900.

4. Discussion on the diagnosis and treatment of injuries of the intestines. *Brit. M. J.*, 2:639, 1921.

5. Enderlen, E., and Sauerbruch, F.: Die operative Behandlung der Darmschusse im Kriege. *Med Klin.*, 11:Pt.2:823, 1915.

6. Finsterer, H.: Ueber Leberverletzungen, *Deutsche Ztschr. f. Chirurg.* 118:1-106, 1912.

7. Kendall, A. I.: Certain fundamental principles relating to the activity of bacteria in the intestinal tract; their relation to therapeutics. *J. Med Research*, 20:117, 1911-12.

8. Lockhart-Mummery, P.: Injuries to the bowel from shell and bullet wounds. *Brit. M. J.*, 2:914, 1914.

9. Makins, G. H.: Surgical Experiences in South Africa, 1899-1900. P. Blakiston's Son & Co., Philadelphia, 1901.

10. McGowan, F. J.: Penetrating wounds of the abdomen. *Ann. Surg.*, 102:395, 1935.

11. McIndoe, A. H.: Delayed hemorrhage following traumatic rupture of the spleen. *Brit. J. Surg.*, 20:249, 1932.

12. Owens, Richard; Fraser, J., and Wallace, C.: Paralysis of the intestine after resection of gun shot injuries. *Brit. M. J.*, 2:9, 1916.

13. Parkes, C. T.: Gun shot wounds of the small intestine. *J.A.M.A.*, 2:589, 1884.

14. Pool, E. H.: Discussion of McGowan's paper.

15. Senn, N.: Medico-surgical aspects of the Spanish-American War. American Medical Association Press. pp. 99 132. 1900.

16. Sims, Marion: The treatment of gun shot wounds of the abdomen in relation to modern peritoneal surgery. *Brit. M. J.*, 2:925, 971, 1881; and 1:186, 223, 262, 304, 1882.

17. SINGER, HARRY A.: Personal communication.
18. WALLACE, CUTHBERT: A study of 1200 cases of gun shot wounds of the abdomen. *Brit. J. Surg.*, 4:679, 1917.
19. WANGENSTEEN, OWEN H.: On the significance of the escape of sterile bile into the peritoneal cavity. *Ann. Surg.* 84:691, 1926.
20. .....: Non-operative treatment of localized perforations of the duodenum. *Minnesota Med.*, 18:477, 1935.
21. .....: Acute pancreatic necrosis with comments on diagnosis and therapy. *Minnesota Med.*, 15:201-204, 1932.
22. WANGENSTEEN, OWEN H.; LEVEN, N. L., and MANSON, M. H.: Acute pancreatitis (pancreatic necrosis): An experimental and clinical study with special reference to the significance of the biliary tract factor. *Arch. Surg.*, 23:47, 1931.
23. WANGENSTEEN, OWEN H. and SCOTT, HORACE G.: Collapse following sudden decompression of the distended abdomen. *Arch. Surg.*, 16:144, 1928.
24. WHITMAN, ARMITAGE: Oxygen inflation of peritoneal cavity, personal experience. *J.A.M.A.* 74:1021, 1920.

Central States Society

of Industrial Medicine and Surgery

CENTRAL STATES SOCIETY OF INDUSTRIAL MEDICINE AND SURGERY held its Annual Meeting, and a Clinical Session in conjunction with the Illinois State Medical Society convention, at Springfield, Ill., on Tuesday, May 19, 1936, with the following program, in charge of Dr. FREDERICK W. SLOBE, Chairman:

MORNING SESSION:

9:30—"Comparative Methods in Treatment of Fractures," by DR. C. N. PEASE.

10:15—"Congenital Defects Simulating Traumatism," by DR. A. H. CONLEY.

10:45—"General Discussion of Fractures," by DR. J. A. VALENTINE.

11:45—"Dupuytren's Contracture," by DR. G. W. STABEN.

General Discussion.

AFTERNOON SESSION:

2:00—"Injuries to the Brain and Spinal Cord," by DR. A. VERBRUGGHEN.

Discussion.

3:00—"Abdominal Injuries," by DR. ROGER VAUGHAN.

Discussion.

4:00—"Occupational Dermatitis: Etiology, Differential Diagnosis and Treatment," by DR. C. J. WHITE.

Discussion.

5:00—Society Business, DR. GEO. L. APFELBACH.

Urine Sulfate Determinations

as a Measure of Benzene Exposure

THE analysis of urine specimens from 79 dogs subjected to a variety of conditions of exposure to benzene vapor in air showed that a rapid and marked decrease occurred in the percentage of inorganic sulfates of the total sulfates in the urine.* The mechanism of this response is believed to be due to oxidation of the benzene to phenol or phenolic derivatives, which in turn are conjugated in the liver with sulfate ions to form ethereal sulfates, thereby causing a shift to the right in the system inorganic sulfates conjugated sulfates. The shift or decrease in inorganic sulfates is related quantitatively to the severity of the exposure to the point of complete elimination of the inorganic sulfates.

A distinct decrease in the percentage of inorganic of total sulfates occurred with conditions of exposure to benzene which did not produce anemia or leucopenia; with conditions which produced benzene poisoning, a marked decrease in sulfates occurred weeks and months in advance of anemia, leucopenia, and the common signs and symptoms of poisoning. The striking nature and reliability of the change in the sulfates in the urine of a person exposed to benzene should serve as an excellent measure of the exposure and potentially harmful conditions in advance of harm to the organism.

The method has other advantages and desirable features. Specimens of urine are obtained more easily from workmen than blood specimens, and the determination of sulfates is a relatively simple and accurate chemical procedure. Since the urine specimen may be taken at the end of a day's work it also furnishes a means for ascertaining the overall daily exposure, which is especially desirable in dealing with situations in which a person might be exposed to widely varying concentrations for indefinite periods during his work.

The purpose of the sulfate test is to help establish hygienic conditions and prevent harmful exposure in the use of benzene. It is not considered to be a method for providing exposure to benzene because the extent to which other agents or physiological or pathological conditions may affect the sulfate response has not been determined. Since conjugation of the sulfates takes place in the liver, severe liver damage, as in carbon tetrachloride poisoning, would tend to retard conjugation and thereby decrease the sulfate response. The sulfate test also is not to be considered a method for diagnosing benzene poisoning, because the changes are merely indicative of exposure and not of poisoning or damage. There is a condition of marked decrease in the inorganic sulfates preceding benzene anemia; likewise there can be definite anemia with the sulfates at normal values, owing to a previous termination of exposure and a more rapid return of the sulfates to normal as compared with the recovery from the anemia.

However, in the interest of safety, in any potential exposure to benzene, a distinct decrease in the inorganic sulfates is a definite enough indication of benzene exposure for removal of the individual from the place of potential exposure and investigation of the cause. If the sulfates return to normal rapidly it is more conclusive that there exists an exposure to benzene or to a substance that causes similar sulfate changes. Should the inorganic sulfates not return to normal, indicating some cause other than the industrial environment, further exposure still would appear inadvisable until the real cause was established, because the physical fitness of the person for withstanding such industrial exposure would appear to be impaired.

It is believed that the results of these experiments with animals warrant trial of the suggested procedure by industry along with precautionary procedures now in use until the suitability and reliability of the procedure are established in practice. If additional practical tests confirm the good indications obtained thus far the procedure will be an invaluable aid in the control and prevention of chronic benzene poisoning.

* YANT, W. P., SCHRENK, H. H., SAYERS, R. R., HORVATH, A. A., and REINHART, W. H., *J. Indust. Hyg. & Tox.*, 18: 69-88, (January) 1936.

Association of American Railroads

—Proceedings of the Medical and Surgical Section—

THE Sixteenth Annual Meeting of the Medical and Surgical Section of the Association of American Railroads was held at the Stevens Hotel, Chicago, Illinois, May 11 and 12, 1936, the Chairman, DR. J. R. GARNER, presiding.

DR. GARNER read the Chairman's Address, "The Proper Study of Mankind Is Man." (See p. 221, herein). The report of the Committee on Fractures was submitted by DR. R. C. WEBB, Chairman of this committee and Chief Surgeon of the Great Northern Railway. "Predictable Causes of Sudden Disability" was the subject discussed by DR. N. C. GILBERT, Associate Professor of Medicine, Northwestern University Medical School and Attending Physician, St. Luke's Hospital, Chicago. DR. GEORGE G. DAVIS, Associate Clinical Professor of Surgery, Rush Medical College, and Attending Surgeon, Cook County Hospital, gave an address on the subject "Diagnosis and Treatment of Gas Bacillus Infection." The report of the Committee on Developments Resulting from Physical Examinations was omitted because of the absence of the committee Chairman, DR. S. C. PLUMMER, Chief Surgeon of the Chicago, Rock Island & Pacific Railway, although printed reports of this committee were distributed.

DR. GARNER first referred to Pope's famous saying that "the proper study of mankind is man." Comment was made on the early application of steam in railroad work. It is just as necessary to use great care in the selection of employees of the railroads as in the selection and maintenance of equipment. In this connection, the Association in 1925 adopted standards of physical requirements. There are approximately 163 physical defects listed as causes for rejection in these standards. Everywhere one goes in railroad experience, one constantly finds inspection of all equipment in contrast to failure to adequately inspect the human factor. It is indeed significant that Alexis Carroll has said that "man is the unknown." It is important to realize that an early remedy of the defects will often restore the individual as a useful citizen. The Committee on Rehabilitation has done excellent work along this line.

The Committee on Developments Resulting from Physical Examinations has demonstrated a great improvement in man power over former experience. Occasionally an employee has been found who is fearful of the results of physical examination. Reference was made to large groups examined and the tabulation of defects discovered, taken from material relating to pre-employment and periodic examinations, and examinations after recovering from injury. Emphasis should be placed on the early recognition of minor defects which might be the forerunners of serious conditions. It should also be remembered that such defects are more easily corrected when recognized early.

In closing his address, Dr. Garner said that there was much to do yet in the study of the man power of the transportation industry.

IN THE report of the Committee on Fractures, the Chairman, DR. R. C. WEBB, presented a report dated April 15, 1936. This committee was invited to meet with the Committee on the Treatment of Fractures of the American College of Surgeons and was greatly encouraged and stimulated by this meeting. It is believed that the 112 Chief Surgeons of Class I railroads, through their contacts with the 15,000 railroad surgeons, have the best opportunity of assisting in the postgraduate teaching which is necessary to understand and apply the mechanical principles involved. Particular attention was called to first aid and transportation splints and the use of these devices by the Red Cross, by the medical schools, and by the Boy Scouts and Girl Scouts. The fact that the City of Chicago adopted an ordinance in 1935 relating to the placing of approved splints on licensed ambulances was emphasized, and the ordinance was made a part of the committee's report. Editorials appearing in the *Journal of the American Medical Association* for February 22, 1936, and in the March, 1936, issue of *Surgery, Gynecology and Obstetrics* relating to first aid treatment of fractures with fixed traction splints were mentioned. Questionnaires were sent to the 112 Chief Surgeons relating to first aid and transportation splints to get their experiences. A similar questionnaire was sent regarding the x-ray diagnosis of fractures and the extent of the use of the x-ray as a diagnostic tool. Treatment of fractures was also given due consideration. Finally, the committee "feels strongly that certain problems in connection with fractures on railroads are best understood by railroad Chief Surgeons and can be best presented by them." It is also felt "that it would be of considerable mutual advantage . . . if a definite portion of the time of annual meetings were allotted to the presentation of one or more fracture problems and the discussion of these problems by members."

IN PRESENTING the subject "Predictable Causes of Sudden Disability," DR. N. C. GILBERT, of Northwestern University Medical School, realized that this was a difficult subject and that he was presenting ideas for discussion. One must keep in mind that it is necessary to apply the principle of choice in making examinations of injured individuals, and that all possible should be returned to work. Since heart disease is a prominent cause of sudden disability, a great deal of emphasis should be placed on this portion of the subject. It is believed that uncomplicated mitral lesions seldom cause sudden disability, and if such an event takes place it is usually due to intercurrent infection. After acute rheumatic fever the patient should not return to work for a considerable period of time, giving ample chance for recovery. Aortic stenosis is fairly frequent and is always a great risk; these patients have a high probability of sudden disability and are prone to sudden death from angina pectoris. They should not be retained in any instance where they are a risk to themselves or to others. Aortic insuffi-

ciency does not offer the same hazard, but the patients are subject to angina pectoris and also to sudden disability. Luetic infection is very much a sudden disability hazard and should be ruled out. In angina pectoris not only is there a prospect of sudden disability but also coronary thrombosis. The diagnosis of this condition is extremely difficult but is based almost entirely on the history. There have been a number of cases where association with thyrotoxicosis and smoking has been the real cause of difficulty. Cases of coronary thrombosis should not be returned to work —they frequently occur after some mild infection. In the abnormal rhythms there is frequently no significance in the young, but in older men ventricular tachycardia frequently means coronary disease and these conditions present hazards. In high blood pressure, life is definitely shortened and sudden disability may occur during work. Those persons with high diastolic pressure, kidney disease or lowered cardiac function are more liable to sudden disability. A falling blood pressure is a bad sign. In thyrotoxicosis sudden disability does not occur so often, but occasionally there is fibrillation. Duodenal ulcer has not been mentioned as a cause of sudden disability, but it can be and has been in some instances. It is equally true that primary anemia may also be a cause of sudden disability. In diabetes, anyone using insulin should be in the class of persons in whom sudden disability may be expected. The patient is liable to be very careless in his diet, except that there are persons who follow rigidly a weighed and measured diet in which the hazard is materially reduced. Lues always is a potential risk. In the discussion of this paper the fact was brought out that in diabetics one would rather keep the blood sugar high in those persons who are taking insulin—in other diabetics it is advisable to keep the blood sugar about the normal percentage. Duodenal ulcers tend to recur, and every diagnostic means should be used to ferret out the occurrence or possibility of hemorrhage. Cases of cerebral sclerosis obviously are subject to sudden disability. In heart cases in which there are definite changes in the electrocardiagram, care should be taken to make proper segregations. Persons showing definite eye findings, with hypertension either with or without kidney involvement, are definitely subjects of sudden disability. Finally, it is wise again to refer to lues as being a very definite cause of sudden disability.

DR. GEORGE G. DAVIS talked on "Diagnosis and Treatment of Gas Bacillus Infection." He called attention to two types of gas bacillus infection: local, in which the infection is very similar to a staphylococcus infection, and the second type, a general involvement which is similar to a streptococcus infection. The essayist referred to a previous article which he had published in *Surgery, Gynecology and Obstetrics* in 1916, relating his war experience and showing that a simple x-ray procedure of making films or plates of wounds showed characteristic x-ray findings in these two types of gas bacillus infection. In the local type a halo or longitudinal shadow appears in the vicinity of a wound in which there is a gas bacillus infection; in the generalized infection there is a honeycomb appearance in the muscles, as shown in the x-ray film. In the local infection, incision, debridement and similar procedures are advised; in the generalized infection amputation is the rule and the guillotine amputation is the type used. Lantern slides were shown illustrating the appearance of the gas in the localized form of infection and also in the generalized infection. In performing amputations it is necessary to have a good stump with a lot of covering, and this is especially important in leg amputations where weight-bearing is necessary eventually. It is also advisable to keep in mind that an exposure of a considerable amount of tissue to the air is wise. Experience has shown that gas bacillus infection may occur after operations on the gastro-intestinal tract, particularly in the region of the perineum, and in such instances it has been found advisable to do a high colostomy to avoid this difficulty. Infection around the hips or abdomen of the gas bacillus type is not subject to the treatment previously outlined, but treatment here is accomplished by multiple long incisions and wide drainage. Bacterial cultures are of value in these infections, but the clinical picture is most important because, in the first stage which occupies about the first seven to 11 hours, there is no skin change, and the x-ray is of considerable value here in settling the question of gas bacillus infection, because it takes considerable time to wait for cultures. It is best not to attempt primary union, especially where gas bacillus infection is suspected. The wound should be left open and irrigated periodically. In the author's experience it has been found that ether was not well borne in these instances, and there were two cases of death following ether anesthesia. Dr. Davis therefore uses scopolamine and morphine in three divided doses, followed by nitrous oxide and oxygen anaesthesia. Regarding treatment, x-ray irradiation is now used and is favorably thought of; it is probable that hydrogen peroxide is produced which assists in clearing up gas bacillus infection. Such x-ray irradiation must be frequent. Another form of treatment which is now available is the polyvalent sera. In summing up the diagnosis, it is believed that the x-ray will give the earliest possible manifestation of a local or generalized bacillus infection for diagnostic purposes, and that the treatment is surgical, x-ray irradiation, and the use of sera.

In discussion of Dr. Davis' paper, DR. JOHN R. NILSSON stated that his experience has been different from that of the essayist; that he did not make use of amputation except where absolutely necessary, but did use wide incision and irrigation. He also reported that he had no ether deaths.

The report of the Committee on Developments Resulting from Physical Examination, of which DR. S. C. PLUMMER is Chairman, was also dated April 15, 1936, and contained statements regarding the questionnaire which was sent to 32 railroads, 28 of which were not in a position to furnish data requested, because of records not being tabulated in such a way as to make information usable. Incorporated in the report also were expressions of opinion from various surgeons concerning the value of physical examinations and re-examinations.

THE Tuesday, May 12, 1936, session opened with the report of the Committee of Direction which was accepted officially.

DR. JOHN MCCOMBE, Chief Medical Officer of the Canadian National Railways, then introduced HOWARD CHASE, Assistant Grand Chief, Brotherhood of Locomotive Engineers, who talked on "Rehabilitation." Mr. Chase first stated that the matter of rehabilitation was perhaps better covered in the United States than in Canada, and that he would limit his address to the latter experience. After injury comes compensation and then restoration to proper function. It is noteworthy that disease also presents a problem, as well as injury. It should be remembered that the interest of the employee is as great as that of the employer in these problems, as the average railroad man expects to stay in this line of work all of his life. It will never be possible to make much progress without the sincere cooperation of the employer and employee groups. Management should take representatives of the employees into confidence. In this respect, the excellent example of Col. Thornton, of the Canadian National Railways, was called to mind—Col. Thornton may be called properly the "Granddaddy" of cooperation. As a result of the efforts of Col. Thornton, labor finally had representatives on the pension committee of the Canadian Railways, ultimately resulting in the employees contributing to the fund. This made it possible to carry on a pension plan which otherwise would have been too great a financial burden for the employers to carry. Mr. Chase thought that in Canada they were more fortunate regarding compensation than in the United States, since the former unsound practices have been done away with by the newer acts in the various provinces. Although not all alike, these provincial acts have much in common—in some the employees have given up their common law rights and special boards administer the law. When a man is living in one province and works in another, or some similar relationship obtains, he can elect the province under which he will conform to the law. The claims departments are, therefore, really out of the picture in the Canadian situation, and it is believed that this is rather an important factor in rehabilitation. In the Canadian railroad experience there has been some difficulty with the physical requirements provisions, since labor had no representative on the committee. As a final result, the Rehabilitation Committee set up a group with employee representation, and this has worked out very satisfactorily. As a result of the work of this combined committee, a considerable number of employees with defects have been found able to carry on. Use is made of the seniority system, and, with a great deal of intelligent cooperation, this has become highly successful. It is Mr. Chase's idea that the Medical Department must be composed of real humanists. There is nothing wrong with the requiring of periodic physical examinations, but this idea should be sold on the basis of cooperation and not of force; successful use of the periodic physical examination can be had without it being made an obligatory measure. Mr. Chase paid a special tribute to Dr. McCombe and the strong Medical Department that he has built up for the Canadian National Railways; the work of Dr. McCombe in this department is worthy of great praise. A valuable loyalty has been created in this department because the employees know that the Medical Department is trying to keep them on the job, and it necessarily takes a long time to accomplish this feeling of security. Mr. Chase advised getting in contact with the general chairmen of the railroad labor organizations and exchanging ideas. He thinks that this will eventually bring about results which would otherwise be impossible. In closing, he said that he hoped that the Medical Departments of the American railroads would be able to put the "soul" back into corporations, as has been done in connection with the Canadian National Railways. Real humanitarian work will always pay.

THE report of the Committee on Disability and Rehabilitation was then read by the Chairman, DR. J. D. COLLINS, Chief Surgeon of the Seaboard Air Line Railway. This report was dated April 15, 1936, and contained among other items a discussion of "Ocular Changes in Diabetes Mellitus." The recommendation was made "in the case of employees in train service, that, at the time when visual tests are made, if any transitory visual defects are noted, such as blind spots, myopia, or transitory symptoms of refractive changes, whether associated with thirst or polyuria, a blood sugar and Wassermann test is advised even though there is not polyuria or thirst present. If sugar is present in the urine, and also if the blood sugar is above normal, we advise that the patient be immediately referred to a competent oculist, besides being placing under proper treatment for his diabetes. This procedure should especially be practiced in the case of enginemen." Brief discussions in this report were given on "Deafness in Locomotive Engineers," in which it was stated that "in all cases of defective hearing a thorough physical and serological examination should be made;" "Head Injuries," in which it was recommended that examination by a neurologist or neural surgeon be advisable in cases of head injury manifesting persistent headaches or dizziness; and "Pain in the Back," this being recognized as a common complaint in railroad work; and advice as to x-rays, foci or infection, diseases of kidneys and abdominal visceral, postural defects, and neuroses, were also emphasized in this report. Considerable space and time were devoted to a consideration of "Cardiovascular-Renal Disease." Twelve different kinds of diagnostic procedures were mentioned, and their evaluation pointed out in different types of cases; these included blood pressure, palpation of pulse, auscultation of heart, uninalysis (including microscopic), blood Wassermann, x-ray of heart (two views plus fluoroscopy), electrocardiogram, blood chemistry, effect of moderate physical exertion, ophthalmological examination, x-ray of extremities for evidence of arteriosclerosis, and the Stieglitz nitrate test for arteriosclerosis. For full details, reference should be made to the complete report. The following statement gives the sense of the committee: "Depending upon the kind and degree of involvement of the cardiovascular-renal system should decide what is best to be done with the individual employee. He should be permitted to continue at work with check-ups at intervals of three or four months; in the meantime he is under the care of his own physician. General hygienic advice and dieting instructions should be given by the examining physician. If the degree of involvement is found to be too far advanced

for the employee to continue in service safely, we advise he be relieved from active duty and his return predicated upon response to rest and treatment." Further discussion was given on the subject of "Inguinal Hernia—Injection Treatment." It was felt that this form of treatment should be practiced only by surgeons who understand thoroughly the anatomy and pathology encountered in various types of inguinal and umbilical herniae, and that meticulous care be exercised in both the selection of the types of hernia to be treated and as to how and where the injection is to be made into the hernial areas. The Committee believed that the injection form of treatment "must not be considered in any way to *supplant* surgery, but its intention is to *supplement* surgery." Regarding the "Thermal Treatment of Neurosyphilis," the Committee recommended that further study and consideration be given to this method of treatment.

After some discussion regarding the portion of the report dealing with the injection treatment of hernia, the report was accepted as a progress report with the understanding that further investigation of the various subjects would be continued.

DR. ROLAND P. MACKAY, Assistant Clinical Professor of Medicine, Rush Medical College, and Neurologist, St. Luke's Hospital, presented a paper on "Vascular Changes, Their Hazards among Railway Employees." The railroad employee often occupies a "critical position," with reference to the effect of vascular changes on the central nervous system. We are, therefore, very much concerned with early diagnosis and treatment in these persons. The fact that various disturbances may come on very suddenly makes them of great importance among these employees. One is very often confronted with the problem of establishing whether a head injury due to a fall is also associated with syncope due to some vascular change; often the final settlement rests with the pathologist. Dr. Mackay then divided his discussion into three parts: (1) vascular lues; (2) hypertension and arteriosclerosis; and (3) spontaneous subarachnoid hemorrhage. Vascular lues is the most common of these conditions among railroad employees, and the intima and media are usually affected, with thrombosis as a frequent phenomenon. These things occur in relatively young men with no previous symptoms. The blood Wassermann will be found to have been positive during a considerable interval of time before the attack. It is for this reason that the yearly Wassermann reaction is advised. Every employee with vascular lues should get proper and prompt treatment, thus cutting down the accidental episodes. Preliminary treatment is extremely important (such as the use of mercury, bismuth and potassium iodide) leading up to the use of arsphenamine and to fever therapy. One of the chief difficulties is to obtain skillful treatment; inadequate and poorly organized treatment is all too common. The second common cause of vascular changes is hypertension and arteriosclerosis. These conditions present an unsolved problem in etiology and treatment on which there is no unanimity at the present time. We are concerned very much with prognosis and removal from active work where necessary. The uncomplicated case of hypertension presents a difficult problem. The diastolic blood pressure is a true measure very often of the mechanical condition of the circulation. Among the criteria for a decision are the following: (a) the most serious sign is a previous cerebral accident; (b) the presence of serious renal damage; and (c) the extent of brain damage can be very often gauged by the involvement of the retinal and choroidal arteries, since these show similar conditions which may be expected to be going on in the brain; hemorrhage, exudates, papilloedema are real signals for removal. Spontaneous subarachnoid hemorrhage is the third great class, and the most serious condition and found mainly in young subjects. There is no way to anticipate this condition as it comes on without warning, although there may be severe headache and vomiting in the first part of the attack. The pathological conditions show that there are many subarachnoid hemorrhages. Treatment is rest, with repeated spinal punctures and the free use of fluids. This condition recurs frequently and no man having it should fill an important position. Other diseases relating to vascular changes are comparatively rare and occur only in isolated instances.

In conclusion, Dr. Mackay stated that the chief concern in vascular changes is to anticipate these conditions and prevent them. This is highly possible in the luetic, and control here is practicable. Hypertension is more difficult, although we have at our disposal the diagnostic guideposts formerly indicated. Subarachnoid hemorrhages present a great difficulty and really constitute a problem. In answer to questions in discussion, Dr. Mackay stated that in regard to the use of fever treatment in paresis approximately 25 to 35% of the patients returned to normal, but each case should be judged on its merits and the man who makes the decision should be held responsible. In reference to the use of mosquitos in the malarial treatment of paresis, Dr. Mackay did not believe that it was necessary to use them in this country where they are continously available for life cycle study.

DR. THOMAS R. CROWDER, Director of the Department of Sanitation and Surgery of the Pullman Company, as Chairman of the Special Committee on the Medical Aspects of Air Conditioning of Cars, read the Committee report. Letters of inquiry were sent out to various surgeons asking questions and seeking suggestions regarding the interpretation of experience with colds, asthma, hay fever, other respiratory diseases, and non-respiratory diseases, and also for criticisms in experience with these conditions and air conditioning. Of the 38 replies received, most all were negative and were not of considerable aid to the committee, but this is not surprising in view of the fact that there is no agreement as to what a cold is and what the etiology is. It is quite likely that there are colds which are infectious and also colds which are not infectious. Exposure to inclemencies sometimes may be an etiological factor if the temperature of the body is considerably disturbed and the temperature regulating mechanism somewhat strained. Going from a high temperature into a low temperature or vice versa may be of some moment in the summer time on account of the character of the clothing and profuse perspiration, but this condition has nothing to do with shock, the reaction is mild, passing off very shortly, if the air conditioned temperature is controlled

within reason. Criticism results in many instances because of abnormal reactions to normal conditions. Eight replies showed that there has been some help from air conditioning in hay fever, and there was one reply which was unfavorable. Experience discloses that numerous passengers with hay fever report no ill-effects from air conditioning. Reference was made to the experiments of Dr. Milholland, in which passengers made a trip from Baltimore to New York and back on air conditioned trains with good results. There were fewer replies on experience with air conditioning and asthma, but there were some favorable reports on the subject. The work conducted at the University of Illinois Hospital relative to air conditioned rooms for hay fever and asthma patients was referred to; these patients went about their work during the daytime and spent the nights in the air conditioned rooms. They reported favorable results in sleeping, and comfort during the time they were in the air conditioned rooms. These results were better on cooler and less humid days. As a practical point, it should be kept in mind that the air in the air conditioned cars is filtered, which takes out dust and particulate matter, such as pollen and bacteria, and the temperature and humidity are also regulated. There has been no agreement on other respiratory diseases, in regard to experiences sent in to the committee. There was only one answer on non-respiratory disease, in which the observer felt that neuritis, arthritis and similar affections were aggravated by air conditioning, but there is no scientific reporting of data to support this contention. Most of the replies to the questions were based on experience with temperature, humidity and air exchange; there were some complaints on account of odor, which does not produce a health hazard but which it is desirable to control on account of comfort. There have been no claims registered, so far as known, concerning odor. In summary, the public likes air conditioning and knows that it is a definite comfort factor, thus promoting health; air conditioning provides a practical means of manufacturing good weather inside regardless of the outside weather. The criterion must always be body comfort, and there are no bad effects if the work is reasonably well done.

The Association accepted this report as a progress report.

MR. J. C. CAVISTON, Secretary of the Association, announced the following results of the election of officers, and members of the Committee of Direction and the Committee on Nominations:

Chairman, Dr. D. B. Moss, Chief Medical Officer, Chicago, Burlington & Quincy Railroad; 1st Vice-Chairman, Dr. Duncan Eve, Jr., Chief Surgeon, Nashville, Chattanooga & St. Louis Railway; 2nd Vice-Chairman, Dr. Harvey Bartle, Chief Medical Examiner, Pennsylvania R.R.

Committee of Direction: Dr. G. G. Dowell, Chief Surgeon, Illinois Central System; Dr. H. A. Beatty, Chief Surgeon, Canadian Pacific Railway; Dr. R. C. Webb, Chief Surgeon, Great Northern Railway.

Committee on Nominations, Dr. T. R. Crowder, Director, Department of Sanitation and Surgery, the Pullman Company, Chairman; Dr. William J. Lancaster, Superintendent and Medical Director, Relief Department, Atlantic Coast Line Railroad; Dr. John McCombe, Chief Medical Officer, Canadian National Railways; Dr. John R. Nilsson, Chief Surgeon, Union Pacific Railroad, and Dr. Don Deal, Chief Surgeon, Chicago & Illinois Midland Railway.

Preventive Medicine and Hygiene

Book Review

By C. O. Sappington, M.D., Dr. P.H.

"PREVENTIVE MEDICINE AND HYGIENE", by Dr. Milton J. Rosenau, is an old "standby," but has now been reproduced in a sixth edition in which many sections have been entirely rewritten and other subjects considered for the first time in this book.* In this sense it is a new book.

The work is divided into various sections. Section I, on the Prevention of Communicable Diseases, includes diseases spread largely through discharges from the mouth and nose; diseases spread largely through the alvine discharges; insect-borne diseases; deficiency diseases; and miscellaneous diseases. Section II comprises venereal diseases; sex hygiene; contraception; heredity; drug addiction; and mental hygiene. Section III includes infant and maternal mortality. Section IV treats of the conservation of vision and ocular hygiene. Section V includes information on public health principles and practices, especially relating to infection and immunity, public health administration, public health education, personal hygiene, housing, nuisances, management of epidemic campaigns, quarantine and isolation, maritime quarantine, accidents, and sanitary surveys. Section VI treats of food, including general considerations, animal foods and milk, and meat, fish, eggs, plants and other foods. Section VII relates especially to air, discussing fresh and vitiated air, motion, temperature and humidity; radiation; odors; smoke, fog and dust; bacteria and poisonous gases in the air; and ventilation and heating. Section VIII treats of soil; Section IX is on water; Section X, on sewage; Section XI, on refuse disposal; Section XII, on vital statistics; Section XIII, on statistical methods; Section XIV is in relation to industrial hygiene and diseases of occupation; Section XV, on school sanitation and child hygiene; and Section XVI covers disinfection.

It is very difficult to review in any brief manner a book of 1481 pages, divided into so many different subjects relating to preventive medicine and hygiene, but the best that can be said of Rosenau's work is that it still remains after 20 years the standard reference and textbook on preventive medicine and hygiene.

Of particular interest to industrial physicians and surgeons is Section XVI on industrial hygiene and diseases of occupation, which has been revised and brought up-to-date through the cooperation of Dr. R. R. Sayers and his colleagues in the Division of Industrial Hygiene, U. S. Public Health Service. Of particular significance is the statement that "the story of progress in this field has been tardy, slow and halting. A few landmarks in the history of industrial hygiene in the United States are recalled to reveal the struggle." After this a number

* *Preventive Medicine and Hygiene*, by Milton J. Rosenau, M.D., Sixth Edition. D. Appleton-Century Co., Inc., New York and London.

of dates are given and their significance is commented upon—such as the enactment of various laws and the establishment of various organizations, and publications, including *The Journal of Industrial Hygiene* and INDUSTRIAL MEDICINE. Among other subjects discussed are morbidity and mortality of industrial workers, medical service and sanitation, occupational hazards, occupational poisons, industrial dermatoses, occupational affections, abnormal temperatures and humidities, industrial accidents, special considerations, and research.

In the Section on Occupational Poisons, Bulletin No. 582 of the U. S. Department of Labor, published in 1933 by L. I. Dublin and R. J. Vane, is followed, the material of that publication being reproduced.

In the material given on silicosis, the definition of the American Public Health Association has been adopted. Of particular interest to the industrial physician and surgeon is the discussion of symptomatology, which is certainly up-to-date and to the point—in fact, one of the most important summaries of this phase of industrial medicine, that the reviewer has ever seen. There are a number of ideas which have undergone slight modification since this account was written, however.

Having known Prof. Milton J. Rosenau personally and taken work under him, the reviewer is naturally somewhat hard pressed adequately to express himself concerning this volume. Perhaps one can only say that no medical library, whether private, institutional, or public would be complete without this volume on "Preventive Medicine and Hygiene."

The Qualifications of a Successful Industrial Nurse

By JOANNA M. JOHNSON, R.N.,
Senior Nurse,
Industrial Nursing Service,
Employers Mutuals, Wausau, Wisconsin

WHERE may we secure the services of an industrial nurse? We'd like a nice, motherly type, an older woman, to whom the girls might go for advice and to whom the men would feel free to air their family troubles. We do not care particularly whether or not the nurse is a registered nurse or an undergraduate; we do want her to be a friendly person and someone who will get along well with the employees and who can do some first aid work." The employer asking for this information knows little about the exacting problems of health work in industry.*

We cannot expect management, which is intent upon the successful operation of its business, to know of the opportunities for service which lie at the door of every industrial health nurse. Industrial physicians, personnel managers, insurance companies, and public health agencies should be interested in educating employers regarding the need of well trained nurses in industry. The industrial nurse, if well equipped for her work, is in no sense a mere finger bandager. Whether she wills it or not, she becomes a health teacher, either a good one or a bad one, depending in full upon her ability to do the job.

Several exacting qualifications are essential to consider when choosing an industrial nurse. Physical appearance is important, since a personally attractive nurse readily encourages the employee to take advantage of the service of her department. Good health is an essential requisite. A healthy body and a good nervous system are required to do successful industrial health work. The nurse must be friendly—not intimate—but have a kindly feeling toward others, which reflects in her personality and in her attitude toward people with whom she comes in contact. She must have a sense of humor and keen sympathy and understanding, be eager to learn and to teach. She must be willing to work hard for the improvement of conditions surrounding the employee, for in that manner she can best promote the spirit of goodwill. She must realize that she is a part of the production program, and that to keep workers fit and on the job is of paramount importance to the employees and the employer alike. The nurse in industry should have sales ability of the highest order. She must create and sell goodwill, which cannot be measured in terms of a definite price, and which she can deliver only through the application of all that is within her.

The human factor is the soul of industry, and a nurse who does not establish friendly relationships between all departments is not worthy of her position. Good sense and appreciation of human value are qualifications which should not be overlooked. All of the theory she has learned and all of her training are as naught in comparison to these. Only with these can a nurse apply to the best advantage the skill and knowledge she may have.

Professional qualifications are important. The nurse should be a graduate of an accredited school. Previous experience is valuable; experience which has taken the nurse into the realms of public health work enables her better to apply the teaching from this field to her fellowmen. A postgraduate course in public health nursing will give her a keener viewpoint on community health problems and lead her to adopt the various public health agencies as valuable aids in the promotion of health work in her particular plant. The nurse must possess professional dignity, and she must have a tolerance toward the worker which will not permit pettiness or gossip. Enthusiasm toward her work, loyalty to her employer, and a realization of the possibilities of her job are, therefore, essential.

The fact that many industries have but one nurse makes it just that much more necessary to employ only the best prepared nurse. Upon her ability depends the development of the nursing service that will secure for itself the proper recognition and appreciation of its value; her department will succeed only in the direct proportion to her ability to build and create a department which will fill the need of the industry in which she serves.

In the small plant the employer knows the names of all the employees. He frequently has personal contact with them, knows much of their family background, their financial problems, and their physical handicaps. This is not true in the larger organizations where the executives must spend more time in the promotion of their product, and in consequence have delegated the contacting of individual employees to the personnel department. In smaller plants it may well be the industrial nurse, who, because of her ability to inspire

* This is the second of three articles by Miss Johnson. The third will appear in *Industrial Medicine* for June, 1936.

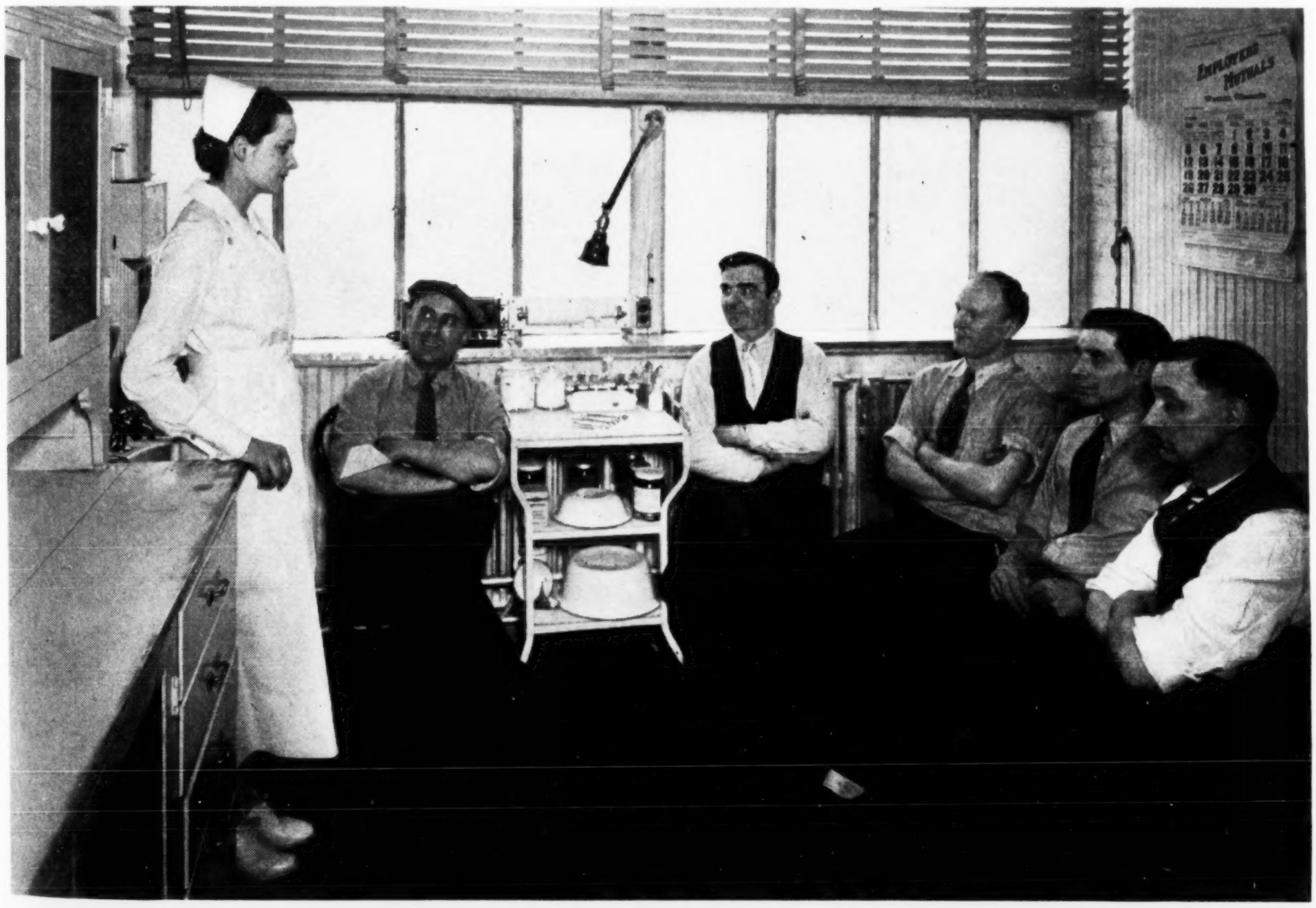
Physical Qualifications	Personality Qualifications	Professional Qualifications
1. Good Health, with a knowledge of its development and maintenance. 2. Attractive Appearance. 3. Neatness and Cleanliness. All of the above may be expressed in: (a) Posture; (b) Condition of Skin and Hair; (c) Body Weight; (d) Uniform. (Outline by Dr. W. A. Sawyer, Medical Director, Eastman Kodak Co., Rochester, N. Y.)	1. Cheerful Disposition: (a) expressed in voice and manner. 2. Tolerance toward all: (a) disinclination to pettiness; (b) absence of superior manner. 3. Alertness: (a) interest in learning. 4. Assurance: (a) courage; (b) calmness; (c) leadership. 5. Honesty and Integrity.	1. Cooperation: (a) "making a better product at a lower cost"; (b) prevention of accidents; (c) supporting morale of those injured; (d) willing to work overtime; (e) knowledge of plant. 2. Interest in Her Job: (a) workers and their problems; (b) desire to teach better living habits. 3. Professional Dignity: (a) avoid gossip; (b) friendly, not familiar. 4. Sense of Order: (a) records; (b) supplies; (c) dispensary.

Necessary Qualifications for a Successful Industrial Nurse

confidence, represents management in expressing and interpreting its interest in the workers.

To whom, then, should the employer go for help in securing the services of a nurse with the qualifications required for a successful department?

Through my years of contact with various industries, I have found that an employer invariably thinks back to some nurse whom he has met in a hospital or home through the illness of himself or a member of the family; the fact that she has given satisfaction in bedside nursing makes him feel that she would be successful in industrial work. This may be true, yet a nurse who works in industry, frequently alone, should have many qualifications beyond those of bedside nursing; and an employer should select her carefully for this important position, since if cutting costs becomes essential, the first department to be cut is inevitably the medical department unless it has proved to be an indispensable part of the production program. I know of plants which have found it necessary to cut costs at all corners but which have maintained their nursing department because of the splendid work the nurse has accomplished. For example, decreasing lost time, whether it be through accident prevention, pre-



The Nurse Meets with the Accident-Prevention Committee

vention of illness, or shortening the disability period through close contact with the worker, is, in itself, a definite money-saver.

Since a nurse must have so many qualifications if she is to make good in industry, it is desirable to hire her through some official nurses' registry, such as can be found in all cities. Industrial physicians and surgeons who have gained first hand information about the industrial problems from their frequent contacts with industry and their varied industrial practice are well qualified to advise as to the proper selection of a nurse to fit the needs of industry.

I bring this subject to attention because of the interest and faith I have in the well prepared industrial nurse. If the nurse has not been well chosen and is not adapted to industry, and many are not, the department suffers, and, as a result the employer becomes discouraged and abandons the project, and will have no more of industrial nurses. He neglects to take into consideration the fact that you cannot fit a square peg in a round hole. If he finds his secretary or stenographer to be incompetent, he immediately dispenses with her services and secures another, perhaps more carefully selected. There is no reason why an employer should tolerate the services of a nurse who is not adapted to this phase of public health work.

The demand for industrial nurses will develop only in proportion to the benefits derived from their services. It is, therefore, reasonable to assume that the selection of the nurse is of paramount importance, and that her qualifications should be such as to reflect in industry the improved health and morale of the individual worker.

Cellular Reaction To Silica

FALLON and Banting studied the cellular reaction produced in rabbits by the subcutaneous injection of hand-picked quartz that had been reduced to a fine powder.* Weighed quantities of the material were added to distilled water so that each cubic centimeter contained 40 or 60 mg. of the powder. The suspension was autoclaved for 30 minutes and 0.5 cc. was injected subcutaneously under aseptic conditions into the external surface of the ears of 24 rabbits. For microscopic examination of the effects, sections of the ear were punched out with a large cork borer. The sections taken at 10-minute intervals during the first 60 minutes showed a gradually decreasing amount of intercellular fluid. In the sections taken between 30 minutes and six days after the injection of quartz particles the reaction was typical of acute inflammation. The quartz particles appear to have a toxic effect on the polymorphonuclear and mononuclear leukocytes and small lymphocytes that enter the aggregations. All these cells are rapidly broken up in this location. Similar cells retain their normal characteristics when they remain in the surrounding areolar tissue. In as short a time as six days the quartz particles become so intimately mixed with cell debris that the aggregations have an appearance of organization. In the sections taken six days after the injection of quartz suspensions the microscopic picture is that of subacute inflammation. The areolar tissue on one side of the cartilage is extensively infiltrated by polymorphonuclear and mononuclear leukocytes and fewer lymphocytes. The mononuclear leukocytes are seen in great numbers in the aggregations of silica particles, where they soon become disintegrated, leaving a framework of poorly staining cells and cellular debris throughout the masses of particles. It is along this framework that the histiocytes later advance into the central portions of the aggregations. Beginning as early as the sixth day and increasing as time goes on, this histopathologic picture gradually changes to that of chronic inflammation. The tissue histiocytes and adventitial cells of the blood vessels are mobilized, take on an ameboid appearance and advance toward the aggregations of quartz particles and cellular debris. Many of these cells are seen in mitotic division. Active phagocytosis of the cellular debris and engulfing of the quartz particles are carried on by the histiocytes until the entire mass, except for a few of the larger quartz particles, is taken up by the histiocytes. This process is complete in the smaller aggregations by the third, and, in the larger, by the sixth week. While changes are taking place in the aggregations there is an active granulation tissue formation in the surrounding areolar tissue. Numerous thin-walled blood vessels are formed and carried into the nodules in long, thin strands of elongated, spindle-shaped cells. From the sixth week onward the microscopic picture is that of scar tissue formation. The phagocytic cells become elongated and spindle shaped. This process begins at the periphery and extends toward the central portions of the nodules. Hyalinization begins at the outer margin and follows to the center of the nodule. As this change progresses there is a proportionate decrease in cellularity. The cells disappear by a gradual diminution in size, and simultaneously there develops intercellularly a firm fibrous tissue which ultimately forms the silicotic nodules. The cells in the central portions of some of the nodules break down and disappear, leaving irregularly rounded collections of a very finely granular substance. This has the appearance of caseous necrotic material and by micro-incineration is shown to contain a large amount of siliceous material.

* *Canad. M. A. J.*, 33:404, (October), 1935; Abstr. *J.A.M.A.*, 105:1808, (November 30), 1935.

Exposure to Ethyl Gasoline

TWO hundred and fifteen persons, 107 of them tank attendants, 61 mechanics, and 47 chauffeurs, were subjected to a clinical examination in 1934 after being exposed to ethyl gasoline for about one year.* No symptoms of lead poisoning whatever were found in any of those examined.

The result of this investigation coincides with the American investigation referred to, (Kehoe, et al), with which, however, it is not entirely commensurable in that the exposure to ethyl gasoline was considerably less in the present investigation, than was the case in the American one. With this reservation, then, the result reported may be considered as an expression that the use of tetraethyl lead as an admixture with motor gasoline in quantities hitherto used presents no danger of lead poisoning.

* Lind, Gerhard, M.D.: *J. Indust. Hyg. & Toxicol.*, 18:37-41, January, 1936.

Who's Who in I. M. & S.

—Little Portrait of a Kindly Man—

THIRTY-ONE years ago last month a serious-minded young man came over from Iowa seeking a job as draftsman in the headquarters offices of the C. B. & Q. R. R., in Chicago. He was sent to the Medical Department to be examined upon his physical fitness for the Voluntary Relief Association membership which, in those days, was the *sine qua non* of working on that railroad. The doctor who took him in charge went over him carefully, and then, after an ominous pause, he said:

"You are practically blind in one eye. That, of course, makes you ineligible."

"But Doctor I've been running a transit and you only need one eye for that and my good eye is good and I never had any trouble with it and I can draw as well as anyone who has two eyes—"

DANIEL BOONE MOSS

The Doctor listened as the young man poured out his plea. His own eyes were keen and kindly. And after a while they seemed keener and more kindly. And maybe there was even an understanding smile in them as he said:

"Well, you go on back upstairs, and we'll see what happens."

The young fellow did as he was told. And things happened. He made good, was promoted, and four years later left to accept an offer too interesting to refuse—which, after all, was a lot to happen in such a short time. But that was only part of it, for he took with him the indelible memory of the splendid kindliness of the tall young Doctor with the bright brown eyes, who broke—or, at least, badly stretched—a rule of rules in order that one youth might have his chance.

That was 31 years ago, and Dr. Moss is older now—but his brown eyes are still as keen as they ever were, and infinitely kindly . . . .

DANIEL BOONE MOSS, M.D., Chief Medical Officer of the Chicago, Burlington & Quincy Railroad, and newly elected Chairman of the Medical and Surgical Section of the Association of American Railroads, was born at Palmyra, Mo., June 9, 1872. Like so many of the professional men whose records are the stuff and fibre of American life—and who, by their ways of making those records, weave into its fabric the form and color of the American pattern — his extraction has deep roots among tradition's underlays. Palmyra is in the midst of an area which was settled and developed by newcomers from older areas of the East and South; hardy souls, westbound, "who hailed the hillside haven from the prow of pioneering landcraft, wheeled Mayflower, and stopped, and tired oxen turned to plow." Drawing essentially from the American quality which made the eastward states and then rolled on to the winning of the West, this section "is really a kind of microcosm of the country, a United States in miniature." Daniel Boone moved into it from Kentucky in 1795; the horn peg on which for the last time, in 1820, he hung his coonskin cap was in a cabin near its southern edge about 60 miles due south of Palmyra. And from the background of his years at Hannibal, only a dozen miles or so away, one Samuel L. Clemens copyrighted "The Adventures of Tom Sawyer" in 1875—just three years after the newest little boy in the Moss family had been named Daniel Boone, for his mother's great-grandfather's brother.

This boy grew up on a farm, went to the nearby district schools, and in due time enrolled at Seminary College, at Palmyra. Graduating there, he turned down-river for his medical education; Missouri Medical College, at St. Louis, (absorbed a few years later by Washington University School of Medicine), gave him his M.D. in 1896. A year's internship at Missouri Baptist Hospital, St. Louis, was followed by a year in general practice at Hannibal. This was satisfactory enough, but a youthful urge to see a little of the world before settling down had never been gratified, and in the face of such an urge, neither 26 nor twice 26 is old. And so, in June, 1898, when the opportunity to affiliate with the Burlington, as Medical Examiner, came along it was seized upon forthwith; and Dr. Moss has been a Railroad Surgeon ever since. For a while his work was local. Then, in successive periods of about a year each, he was Medical Examiner at St. Joseph, Mo., Burlington, Iowa, Lincoln, Nebr., and Centerville, Iowa. In June, 1903, he was transferred to Chicago, where he was associated with Dr. J. A. Denny, Chief Surgeon and Medical Director. After 20 years in that association, he became Head of the Medical Department; since 1923 he has been Chief Medical Officer.

His Medical Department, serving now about 25,000 employees, has the Grade A Rating of the American College of Surgeons, and is—as most railroad Medical Departments are, and as all industrial Medical Departments should be—under the direct supervision of an executive officer of the corporation.

Dr. Moss does not have many organization memberships. He is a Fellow of the A.M.A., and a member of the Illinois State Medical and Chicago Medical Societies. For several years he has been Secretary of the American Association of Railway Surgeons. He became interested in the Medical and Surgical Section of the Association of American Railroads when it was organized in 1920, attended its third annual meeting in 1923, and in May, 1936, at its sixteenth annual meeting, was elected its Chairman succeeding Dr. J. R. Garner.

He was a member of the Association of Railroad Chief Surgeons, prior to its recent decision to remain inactive.

He is Protestant, and a Democrat, although, as to the latter, he now says: "I don't know." In 1901, he married Florence Cunningham, of Fairfield, Iowa; two children of their daughter—a boy of four and a girl of three—help to keep him young.

His avocation is internal medicine; he stays pretty steadily abreast of all its developments; study of its current progress he considers a recreation.

He is a fisherman, but, for him, fishing is neither diversion nor recreation; it is much more, a real hobby—"favorite and ever-recurring subject of thought and effort." He has done much of it, wherever the fish are—in land-locked waters, however, because he never cared for deep-sea fishing, preferring the kind that lets him put on his boots and stand long hours with his feet in the flow. He has caught trout in mountain streams, bass in rivers, muskies in lakes, in nearly all parts of the United States and Canada. But for many years fishing has been vastly more in his thought than in his effort; he hasn't fished as much as he wanted to. He says he goes whenever he can. Those who know him, however, know better. He may not have fished as much as he wanted to, but he certainly has not fished as much as he could have. There is a reason.

And the reason is of the essence of the personality which is D. B. Moss, M.D.

INDUSTRY, as we have often said in these pages, is the aggregate of all kinds of employment. Wherever the minds of two persons meet in the relation in which one becomes the party of the hiring-and-paying part and the other the party of the working-and-earning part, there is "industry." And the boundaries of "industrial" medicine and surgery are defined by the extent to which the services of the medical profession are economically necessary to this contractual relation.

"Industrial" medical work, therefore, is a wide field. And its farthest boundaries are probably more clearly indicated in railroad medical service than elsewhere, because, in the railroad industry, employer and employee are working together in the business of transporting people, and the medical service must recognize certain of the problems these people present as well as the problems inherent in the employer-employee status. Thus such matters as public health, sanitation, water supply, quarantine, epidemics, hygiene, even air conditioning, are within the essential scope of its interests.

The record of the railroad medical officers in these respects is an open one, and he who travels may read; they handle these things with the sure touch that comes from knowledge, and the sound judgment that evolves from experience. And so they are skilled in executive and administrative responsibility, and accustomed to the larger view which treats with humanity in numbers. But they are, nevertheless, still Doctors, still interested in the aggregate in terms of the individual, still governing their every human contact in terms of the sacred personal relationship which makes the Doctor the persistent individualist the Doctor must be.

The railroad employee himself likewise presents certain problems which are not so frequently found in other industries. Among these is the interest manifested in each employee by one or another of the 21 railroad labor organizations, an interest which sometimes seems almost equivalent to the *locus parentis* of the practice of law. But this, to the Doctor, is not so much a problem as an adaptation. The measure of its successful handling, however, is once more the personal relation—the labor union representatives invariably *know* their Doctor.

Picture, then, the Physician and Surgeon growing, through the years, into the personal acquaintance, confidence, respect, and even love, of the men who along with him are also growing in the length of their lifetime-service, and as he grows in these elements of his professional career, developing also in the superimposed elements which make him finally an executive as well—picture this, and you have the railroad Chief Surgeon, or Chief Medical man. Go a little further; and, with both phases of the development at the full 100%, add still more to the fine sense of personal responsibility which while he was becoming the executive kept him becoming still more the Doctor—go this far, and you have *this* Chief Medical man. For, regardless of everything else, to the men who have worked with him on the Burlington for nearly 40 years, Dr. Moss is *their* Doctor Moss.

He won't remember the act of kindness which made such a profound impression upon the recollection, and the life, of the young man 31 years ago—he won't remember it any more than a man remembers the details of any habit—of how, for example, he lighted up his after-dinner cigar on a given evening.

Such kindly things are this man's habit. They were always his habit of heart, and he has made them his habit of life these many, many years. He is a kindly man.

And he doesn't give very much time to memberships, and meetings, and he doesn't go fishing nearly as often as he wants to, because there is hardly a day goes by that there isn't somebody from somewhere along the Burlington's 13-state mileage coming in to see, not Chief Medical Officer Moss, but *Doctor* Moss.

They come with confidence; and he stays in his office so they will find him when they arrive; *his* office, where he likes to stay, a kind of shrine—of the Physician and Surgeon's *personal* relation apotheosized.

We leave him in it.

Industrial Medicine

—Abstracts of Papers on Industrial Medicine, American Medical Association Convention, Kansas City, Mo., May 13, 1936—

THE 87th Annual Convention of the American Medical Association at Kansas City, Mo.; the Section on Preventive and Industrial Medicine and Public Health presenting a program on Industrial Medicine, on the afternoon of May 13, 1936; Dr. R. R. Sayers of Washington, D. C., Chairman of the Section, presiding:

The Chairman's address was given on "Industrial Hygiene Problems in the United States."

DR. GEORGE H. GEHRMANN, of Wilmington, Del., presented a paper on "Papilloma and Carcinoma of the Urinary Bladder in Dye Workers."

"Anthracosilicosis" was the title of a presentation by DR. W. C. DREESSEN, of Washington, D. C.

DR. HENRY FIELD SMYTH, of Philadelphia, discussed "Safe Practices in the Industrial Use of Carbon Tetrachloride."

The interesting program was closed by DR. H. H. SCHRENK on the subject "A New Procedure for the Control of Benzene Poisoning," based on studies made at the U. S. Bureau of Mines, Pittsburgh, Penna.

DR. SAYERS stated that industrial hygiene could be defined as a branch of preventive medicine having to do with the health of the working population. Occupational disease is somewhat difficult to define, but is defined by laws in various states. In some of these states the definition is definitely limited by schedules. The descriptive definition of an occupational disease as recently passed by the Illinois State Legislature was read and referred to. The objective of industrial hygiene, in addition to the control of occupational diseases, is definitely the protection of the health of the workers and includes, besides the control of occupational diseases, attention to sanitation, lighting, temperature, nursing, personal hygiene, and many other subjects—in short, adult preventive medicine. It is essential for us to know how, when, why, and where occupational diseases occur in industry. The census data of 1930 have been taken and tabulated according to industry—covering particularly the mechanical, manufacturing, and mineral industries comprising about 15 million persons. It should not be concluded that all of these people are affected by occupational disease by any means. Tabulations were made by the speaker, according to states showing the percentages of different persons in various states in the industries as mentioned. A tabulation was also displayed showing diseases of specified duration. Reference was also made to the difference in life expectancy of industrial employees and non-industrial persons, according to Dublin's figures. The U. S. Public Health Service has been collecting sickness data of benefit associations on about 160,000 individuals. At the present time data are being gathered on approximately 600,000 persons which will be segregated according to occupation, industry, age and other particulars, and should be of great help in future problems. Another important method of use in these problems is what is known as the preliminary survey which, it must be understood, does not include the actual measuring of exposure. In association with this, an occupational analysis is done, and then exposures are measured and the occupations are ranked according to the actual incidence of the exposure. A map of the occupational disease laws and their provisions in the various states of the United States was shown, and its significance explained. Reference was also made to the intense interest displayed by the various states at the present time in forming industrial hygiene units, which will be attached to the health departments in most instances. In summary, industrial hygiene was described, including occupational disease, and the number of persons employed in industries having a potential health hazard was shown according to the distribution of these persons. Recent developments in determining occupations in which hazards are most prevalent were detailed, and recent developments looking to the control of these hazards sufficiently outlined.

DR. GEHRMANN, in presenting his experience regarding "Papilloma and Carcinoma of the Urinary Bladder in Dye Workers," said that papilloma and carcinoma of the bladder in dye workers were first described in Germany in 1895. By 1924 the medical profession became convinced that there was a definite relationship between the exposure and these abnormalities. In 1925 the German government passed a law making papilloma and carcinoma of the bladder due to dye compounds compensable. The first case detected in this country occurred in about 1931. Referring to etiology, it was stated that prolonged exposure to low concentrations of dye intermediates is known to have caused tumors of various kinds. The evidence is admittedly not conclusive, because in certain instances other substances may be responsible. The various compositions enter the circulation through the respiratory system, the skin and the gastrointestinal tract — mainly through the respiratory system, although a few come through the skin. Regarding age distribution of the 24 cases of carcinoma described, it was shown that no particular age demonstrates a higher incidence than other ages, the tumors occurring throughout the industrial age period. The average exposure of these cases was 13.2 years, with a minimum of five years and a maximum of 20 years. In regard to 31 cases of papilloma, the age again was not of significance and the average years of exposure were 12.07. An important fact has been demonstrated relative to bladder tumors in dye workers, which is that the development continues after removal from exposure. In the symptomatology the outstanding findings are hemorrhage, urinary frequency and urgency, and pain, which are really the classical symptoms in advanced cases. Diagnosis is accomplished by cystoscopy, supported by biopsy. The tumors are of all types, benign and malignant, infiltrating and non-infiltrating, and have other variable characteristics. In 124 German cases reported by Gay the occurrence of car-

cinoma was twice that of papilloma—in the American group reported by the speaker, the reverse was true. All such bladder tumors should be regarded as potentially malignant, and check should be made by microscopic examination of biopsy material. The tumor may be located at any place in the bladder, but the most frequent site is the paratrigonal space. The pathological changes of these tumors do not differ from bladder tumors of unknown etiology. A number of lantern slides of microscopic sections were demonstrated, showing these characteristic findings. As in the pathology, the treatment does not differ in these tumors from similar tumors of unknown etiology. Early diagnosis is extremely important, and benign tumors may be treated successfully by fulguration; carcinomata demand extensive treatment over some period of time. There are two types of preventive measures, plant operative control and medical control. In plant operative control, the employees should be completely protected from dust and fumes, by enclosed systems, and also by accessory exhausts with remote discharge. The German experience has been successful in this connection and no new cases have been reported since these measures were properly instituted, although old cases from previous exposure have been uncovered. Medical control consists of cystoscopy examinations periodically, and a regular monthly physical examination. In pre-employment examinations any disease of the genito-urinary tract is a contraindication for employment in dye work, and it is advisable to limit the age grouping to persons who are not under 21 or over 40. Attention must be given to change of clothing and baths. These measures apply equally to mechanics who are doing repair work in various departments, although they may not be regular employees of the dye works. All persons should be given a complete physical examination and cystoscopy at least once a year and a urinalysis every three months. The prognosis is good in benign tumors and of course is highly variable in carcinoma. In summary, certain nitro- and amino- compounds are capable of producing bladder tumors; periodic cystoscopy is the one diagnostic procedure which permits of early detection, which should be confirmed by microscopic examination of biopsy material.

DR. DREESEN, regarding "anthracosilicosis," said that this disease is an occupational disease and is produced by exposure to anthracite coal dust and free silica dust in combination, and referred particularly to the anthracosilicosis study published by the U. S. Public Health Service, as Bulletin No. 221. Over 2700 men were included in three different anthracite coal mines in this study. It was discovered that the hazard varied directly according to the concentration of the dust and its free silica content. The median size of the particles in these exposures was about 0.9 micron. A division was made of the occupations and the amounts of free silica and concentration of the dust to which these occupations were exposed, as follows: regular miners 3 to 4% free silica and 20 to 480 million particles of dust per cubic foot of air; employees in the haulageways, 13% free silica and 17 million particles of dust per cubic foot of air; the rock tunnelers and muckers, 35% free silica and 250 to 520 million particles of dust per cubic foot of air. As a control group, the investigators selected those who were exposed to less than five million particles of dust per cubic foot of air and no significant fibrosis was found in the group exposed to this concentration of dust. Dr. Dreessen stressed particularly the importance of a proper occupational history, taking account of the factors of dust concentration and free silica content. The method of making up a weighted figure as to exposure in various occupations was demonstrated, using the number of years of exposure, the millions of particles of dust per cubic foot of air, and arriving at a figure which expresses millions of particle-years exposure. This tabulation has appeared in several of the U.S.P.H.S. publications. An important point brought out with this study is the similarity between the effects found in Pennsylvania anthracite miners and miners in anthracite coal mines in Wales and Australia. Lantern slides of gross specimens of lungs and microscopic sections were shown, demonstrating typical findings. In conjunction with these also, chest films were displayed, likewise showing characteristic roentgenographic manifestations. It appears that the latent period in exposure to anthracite coal and silica dusts is about 15 years. Of the group of 2711, 2000 were essentially negative. Several tabulations were exhibited, showing the clinical findings in the various groupings. In summary, the study has disclosed that anthracosilicosis is an occupational disease demonstrating silicotic fibrosis accompanied in some instances by emphysema and a heightened susceptibility to tuberculosis, characterized clinically by dyspnea, cough and pain in the chest. The incidence of tuberculosis was approximately 15% in the early cases and 43% in the advanced cases, with a percentage of two in the controls.

DR. SMYTH in discussing "Safe Practices in the Industrial Use of Carbon Tetrachloride" said that this substance had been in use for many years in various processes in industry and in other places. Cases of fatal and non-fatal poisoning have been reported. It should be borne in mind, however, that the substance can be used properly without bad effects. Published data, however, show gaps in our information relative to exposure; hence the present study in which the investigators have attempted to correlate exposure with the effects as shown by special examinations. In the experimental portion of the study, 333 animals were used, mainly guinea pigs, rabbits and monkeys, and exposed through varying periods of time to concentrations of 50, 100, 200 and 400 parts per million. Actual measurements were taken of the concentrations of pure carbon tetrachloride to which the animals were periodically exposed. Pathologic studies were made of liver sections, sciatic nerves, kidneys, and ocular muscles. It was found that a typical cirrhosis of the liver was produced in rabbits, but not in monkeys. A complete regeneration of the liver occurred in four to six weeks after cessation of exposure. The adrenals were definitely affected in guinea pigs but not in rats and monkeys. From animal experimentation it was determined that 100 parts per million was thought to be a safe concentration. A certain number of dry cleaning establishments were used as the industrial basis for the study, 2000 measurements of the concentration of carbon tetrachloride vapor in air being made; in these instances only

two plants had exposures of more than 100 parts per million. Examinations were conducted on 96 employees, and the measurement of concentration relative to these employees was made at the actual site of the occupation and during the various processes. Measurement of visual fields was a part of this examination, since Wirtschafter has called attention to the restriction of the visual fields in carbon tetrachloride poisoning. The investigators did not find bilirubin or albumin in the urine in the examinations made on these employees; findings were based on an estimation of the sulphates and the total nitrogen. It was found that low calcium and low carbohydrate diet and alcohol increased the effects of carbon tetrachloride vapor inhalation. No real serious effects of the inhalation of these vapors were discovered in the clinical examination data. It is of course acknowledged that subjective symptoms consisting of nausea and vomiting occur in various persons, but these exist only for brief periods of time and are usually due to poor ventilation. Recommendations for the care of workers have been made, and for the selection of employees, according to suggestions previously set down by Dr. P. A. Davis. In closing, Dr. Smyth called especial attention to the findings of this study, which were best demonstrated in the scientific exhibit.

DR. H. H. SCHRENK, of the U. S. Bureau of Mines, gave the final paper of the special session on Industrial Medicine. His subject was "A New Procedure for the Control of Benzene Poisoning." He described the experimental work done at the Bureau of Mines relative to possibility of measuring exposure of benzol vapor, by a method of urinalysis. Recently a micro-color method has been devised for the determination of benzol vapor in air; this method is very sensitive and at the same time has merit in being simple to carry through in the laboratory. Because, however, there is a great variation in the daily and seasonal exposure to vapor and it is difficult to estimate an average daily exposure, it was felt that some other method might be devised for detecting exposure, before the blood changes have come about upon which dependence is usually based for a diagnosis of poisoning in higher concentrations of exposure. Accordingly, experimental research on animals has shown that a decrease in the percentage of inorganic sulphates of the total sulphates in the urine may be taken as a citerion of exposure. A single specimen suffices in this work, and the determination is made by the well-known Folin method. It has been found that the decrease of the inorganic sulphates is proportional to the exposure. In the experimental work, 79 animals were used, and there was a great variation in the concentration of exposure. It must not be forgotten that this is not a diagnostic measure, but is rather a measure of the exposure than any attempt to estimate the damage done by actual poisoning. In a group of five plants, 50 urine specimens were taken from employees and the decrease in the inorganic sulphates was correlated with the blood findings and the measurement of vapor concentration; all of these data bore a very definite relationship to each other, and the urinary findings are significant in their relationships to the blood findings and the air concentrations. In summary, a correlation of results obtained from a study of chronic benzol poisoning revealed that exposure to benzol caused a striking, easily measurable, consistent and rapidly occurring decrease in the percentage of inorganic sulphates of the total sulphates in the urine. The decrease occurred far in advance of anemia, leukopenia, or signs of harm, and was quantitatively related to the benzol exposure regardless of whether the exposure was for a long period to a low concentration or for a short period to a high concentration. The method has no diagnostic significance, however, and must be used as a reliable method of measurement of exposure to benzol vapor.

Dermatology Related to Trauma

By B. BARKER BEESON, M.D.,
Professor of Dermatology and Syphilology, Loyola University School of Medicine; Attending Dermatologist, Cook County and Mercy Hospitals, Chicago.

THIS article will not take up the usual skin lesions which follow an injury to the integument; it will be limited to a practical and largely clinical resume of three disorders whose lesions may appear upon the skin following an injury.

The first and most important of the trio under consideration is syphilis. In this connection I shall limit myself to those lesions of syphilis which occur in latent tertiary examples of that disorder and not take instances of inoculation by intermediate objects or syphilis acquired by physicians in the practice of their profession.

So-called traumatic syphilis was probably first studied in the 19th century. Verneuil, a French surgeon, described cases of that nature in 1863. In 1875 his pupil, Petit, dedicated his M.D. thesis to this subject. In his Treatise of Syphilis, published at the very beginning of this century but unfortunately unfinished, Fournier cites a number of examples, most of them valid in spite of the more recent acquisitions to our diagnostic armamentarium. Since then, and especially with the newer laws dealing with workmen's compensation, this question has been the subject of much careful study by a large number of clinicians, among whom are Milian, Gougerot, Clement Simon, Raymond Barthélemy, Olivier Lenoir, Louis Bory, Urbach, Pasini, Klauder, Michael, etc.

When one considers the number of syphilitic patients who are injured while at work or otherwise it appears that traumatic syphilis is a real rara avis. Such lesions may follow slight repeated trauma, or, as is perhaps more often the case, come following a single more or less violent trauma. Urbach has stated that traumatic syphilis is more frequent after a contusion rather than a deep wound. Naturally a large number of agents may produce injuries, mechanical, physical or chemical. Injuries resulting from operations, injections, tattooing, while rare, have been reported by competent observers.

There are three theories as to the pathogenesis of traumatic syphilis. The first is that of Pasini

---

• Presented before the Congress of Railway Surgeons, Chicago, November 13, 1935.

who believes that the injury modifies the biological properties of the tissues and especially its capacity for resisting the spirocheta pallida. This resembles closely Verneuil's idea. Clement Simon has put forth an ingenious explanation. He believes that these local manifestations of spyhilis appear when an injury affects a region where living spirochetes are lying dormant as in the bones, for the marrow is rich in those organisms even during latency. Milian believes that following trauma there is a disturbed capillary circulation which allows the spirochetes to pass out into the tissues and thus in some instances produce lesions.

Slight Repeated Trauma

HALBRON and Barthélemy have recorded an unusual case in which a shoemaker produced psoriasiform syphilides on his right palm as the result of oft-repeated pressure from his tools. Crepin has observed a telegrapher who presented similar affairs where his key was pressed upon. Jose May has described three characteristic examples of pre-patellar gummas in scrubwomen. But Lacapere and Laurent bear away the prize for their collection of 29 cases of frontal gummas among Mohammedans in Morocco. These lesions resulted from pressing the forehead against the floor of the mosque during the five daily prayers which are expected of all true followers of the Prophet. Raillet has seen a baker who presented nodular syphilides of both forearms following the continual scraping off of dough with a pastry knife.

Traumatic syphilis almost always occurs in the so-called tertiary cases, occasionally in the secondary period, but almost never in the primary, according to Eliet.

A Single More or Less Violent Injury

CREPIN cites a case of nodular syphilides appearing on the leg after the kick of a horse. Brouardel mentioned a patient with a dislocated shoulder upon which gummas appeared. Fournier saw a man who had been syphilitic for 10 years who was knocked down and run over by a carriage the vehicle passing over his left leg and producing a large contusion. Soon after the scar had formed a syphilitic gumma appeared at the site of the injury. A man 87 years old had contracted syphilis when 20. He dislocated a shoulder. Following an unsuccessful attempt at reduction nodulo-ulcerated syphilides came out over the joint. Fournier also reported the case of a blacksmith who was burned over the sterum with a redhot horseshoe. The wound had scarcely healed when a crop of ulcerated nodules came out upon it. Another man dropped a potful of very hot water upon his left thigh. Several weeks after the burn had healed its site became covered with nodular syphilides.

As Assistant Chief Surgeon to the State Railways of France, Barthélemy has seen some unusual examples of traumatic syphilis one of which may well be quoted. A passenger on a train was about to alight when a sudden application of the brakes threw him against the side of the compartment. This produced a contusion under the left breast. When seen by Barthélemy three weeks later there was only slight pain on pressure over the 7th and 8th left sterno-costal cartilages. The patient said that pimples had come out upon his back since the accident. Barthélemy found a large plaque of nodulo-squamous syphilides, measuring 13 by five centimeters, over the left scapula. The lower portion of this patch showed characteristic smooth, circular, cigarette-paper like scars showing that these lesions had been present for months and were not recent. This shows the importance of knowing the evolution of syphilitic lesions as well as their clinical attributes.

Eliet has recorded the case of a baggageman who, while pushing a heavily laden cart, felt a severe pain in the left shoulder The local physician considered it a mere strain. Three weeks later the shoulder joint was aspirated and 300 cc. of clear fluid withdrawn. There was no pain, but much loss of function. A possible diagnosis of tabetic arthropathy was considered by this time. Eight months from the beginning of his trouble the joint was much deformed, not painful, with entire loss of function but with no signs of tabes. A specialist being called in found characteristic scara of syphilis over the shoulder. The man also exhibited leukoplakia over the mucosa of the left cheek. Out of 15 pregnancies, he was one of the only three children who had survived.

Oliver Lenior, Chief Surgeon to the Paris-Orleans Railway, reports the following case which well illustrates my plea for a knowledge of clinical syphilography. A baggageman, 51 years old, was injured by a baggage cart passing over his left foot. He was seen by Lenoir 15 days after his accident. There was swelling over the dorsum of the left foot plus slight pain on pressure over the upper end of the third metatarsal. An x-ray film showed a fracture of the third metatarsal at the junction of its lower third and upper two-thirds. A cast was applied and kept in place for three weeks. At the expiration of that time what appeared to be a cold abscess appeared below the fracture. A second x-ray examination showed an entire lack of union and, moreover, the ends of the fragments were inflamed and appeared to be tuberculous. With this in mind, Lenoir operated 25 days after the accident. The ends of both fragments when exposed appeared definitely tuberculous, so they were resected. The wound healed by first intention. About 12 days after the operation a swelling appeared in the lower end of the scar which soon attained the size of a large nut. Lenoir still believed the whole affair to be due to the Koch bacillus, but treatment along those lines was entirely unsuccessful. By the end of three months the swelling took on the attributes of a true syphilitic gumma, and a history of acquired syphilis was gotten from the man. Under anti-luetic therapy the lesion promptly healed and the foot became normal. This illustrates the importance of keeping syphilis in the foreground in any wound which does not heal promptly.

Michael reported an example of gumma of the lower left leg following a fall from a ladder. He emphasizes the importance of the clinical findings in cases of traumatic syphilis.

Gummatous lesions have followed injections given to patients with latent syphilis. Gougerot, Mibelli, Juliusberg, Pasini, Barbagalia and several have made such observations. Gougerot saw a patient who had given himself intramuscular injections of mercury benzoate. Fifteen, 22 and 29 days after these three injections, respectively, these resembled gummas but were not diagnosed until seen by Gougerot five months later. These

lesions healed three days after three injections of Neo-Arsphenamin, with a total dosage of 1.20 grams. Gougerot's second case presented gummas following morphine injections. They remained unhealed for several years but soon responded to injections of Neo-Arsphenamin. Fournier reported a case of a man who had been syphilitic for 10 years and who developed malaria. Injections of quinine produced gummas at the site of each injection. Lortat-Jacob had a female patient who developed gummas in the arms following injections of ovarian extract.

Diagnosis

AS ELIET has said, a certain interval should elapse between the trauma and the appearance of the syphilitic lesions. He sets this at 10 to 12 days as a minimum.

A diagnosis of spyhilis depends upon the clinical characters of the lesions, on examination of the reflexes and cardiovascular system, on the patient's antecedents, on the laboratory examinations, and, finally, on the therapeutic test.

Fournier has described the gumma so well that his findings are still unexcelled. Since a gumma is almost always seen after ulceration has occurred I shall describe it at that stage. Its outline is circular except when several have merged, when its outline is polycyclic. It is deep with punched out margins. Its edges are firm and adherent and surrounded by a dark brownish areola. Its floor is uneven and covered by a core which resembles cooked codfish or a yellowish creamy exudate. A syphilitic nodule or tubercle is really a large papule set into the skin; it is orbicular as to configuration, and in size often approximates a large lentil. Its color has been likened by Fournier to that of smoked ham. Its surface is smooth. In consistency it is firm. Such lesions are often grouped and tend to a circinate arrangement as arcs of a circle, like a horseshoe or a kidney.

A history of syphilis when obtainable is important, but alas it is often most elusive. Such procedures as the Wassermann or Kahn are of much value when positive. When negative they mean little, and in the presence of undoubted syphilis are merely corroboratory. It is well to remember that in old cases these reactions may be negative in 25 to 30% of cases.

The therapeutic test is still of undoubted value. If the response is rapid then it has a real dignostic value. This applies particularly to the use of mercury, the newer arsenicals and bismuth. Certain mycotic infections respond to potassium iodide, so it should be used in this way.

A tuberculous ulcer is usually shallow, irregular, livid or violaceous, with soft undermined margins, scanty secretion, and often an associated adenitis. At times guinea-pig inoculation may be necessary.

In sporotrichosis the lesions are softer, more polymorphous, more superficial, and they furnish a characteristic cerebriform, chocolate-colored culture which is best obtained from a closed nodule.

One of the most difficult diagnostic problems is furnished by what Gougerot has appropriately termed chronic syphiloid suppurations. They are chronic pyodermas which may produce serpiginous ulcers which are, however, more superficial, less indurated and more purulent than the syphilitic gummas. At times a fringe of epidermis along the edge of such an ulcer will mark the site of a bleb. The therapeutic test would be negative. Too much reliance should not be placed upon negative serology, since a given lesion may heal quickly under anti-syphilitic therapy in the presence of a negative Wassermann or Kahn reaction.

Self-inflicted skin lesions, referred to as Dermatitis Factitia, are baffling at times. It is well to think of them when confronted with lesions in an area of access in one who is probably hysterical, as evidenced by pharyngeal anesthesia. Such lesions may simulate a wide range of skin disorders. Their edges should be carefully inspected for any evidence of trickling of the caustic which is a favorite agent in cases of this sort. The patient may predict the site of new lesions with great accuracy. A fixed dressing may cause a quick cure. It may be necessary to place a metallic plate over such a lesion, since some of these simulators will inject their favorite caustic through an ordinary gauze dressing. A confession may sometimes be obtained, but it requires all the diplomacy and finesse of a Talleyrand.

Among the errors to be avoided is the incision of gummas, as was done in Lenior's case. One should bear in mind that traumatic syphilis may originally affect a bone or joint and not involve the overlying integument until much later. Gougerot has recorded a case in which a knee was injured in 1920 following which an osteo-arthritis with fluid in the joint developed. The bone was scraped, but to no avail. Five years later a large patch of nodulo-ulcerative syphilides appeared in the scar. The possibility of syphilis was still neglected, and the lesions rapidly increased in number. When seen by Gougerot in February, 1928, the diagnosis was self evident. The Wassermann was strongly positive and a rapid recovery ensued following injections of Neo-Arsphenamin.

Syphilis may appear postoperatively, as in Muller's case, which was mentioned by Klauder. It concerned an abdominal incision in whose scar a gumma developed. Coués had a similar experience. Gougerot has described a patient whose external urethrotomy wound became gummatous but healed in one month under injections of mercury biniodide.

Cancer following Trauma

ROUSSY and Heraux have nicely summed up the so-called professional cancers. They mention cancers occurring in chimney-sweeps, tar workers, paraffine workers, cotton weavers, petroleum refiners, aniline dye workers and x-ray operators. It has been known for a long time that repeated trauma, often slight, was capable of giving rise to a cancer. Now we know that a single more or less violent injury may be quickly followed by cancer in situ. Gougerot and Meyer have seen a bronze worker who early in October, 1934, was injured by a splinter of that material running into his left hand. In a little over two months a squamous-cell three centimeters in diameter had developed at the site of trauma. Marcel Pinard quoted a case seen at Amiens in which an injury from a strand of copper wire was followed in two months by a squamous-cell skin cancer. Ravaut has mentioned a man who stepped upon a nail. Within two months a rapidly-growing naevocarcinoma had developed and metastasized to the inguinal glands. He said: "It is worth while to spread the idea that a malignant tumor may de-

velop very quickly following trauma, and the appearence of such a tumor under these conditions should be considered as an occupational affair."

Traumatic Herpes Zoster

THIS was first described by the father of modern neurology, Charcot, in 1859. In a recent review Charlier and Etinne-Martin have collected a number of such cases from the literature. The incubation period varied from one day to one month. Barthélemy saw a freight handler who, while unloading a car, was violently struck on the left side of his body. No wound but a marked contusion was produced. The next morning, or within 15 hours after the accident, he awoke with a typical herpes zoster over the injured area. Schonfeld has collected three instances of herpes zoster in syphilitics following lumbar puncture. Taylor has observed this disorder over the superficial cervical plexus following a fall upon the shoulder. Darier has seen an ophthalmic zoster following a violent cranial contusion received in an automobile accident.

A number of other skin disorders among them alopecia areata, scleroderma, lupus erythematodes, etc., have been reported as following injury.

Conclusions

KEEP syphilis in mind in any skin lesion, following injury, which does not heal under ordinary therapy.

2. In such a case one should endeavor to prove the presence of syphilis by clinical and laboratory means.

3. Syphilis may exist in the presence of negative laboratory findings. It is here that the therapeutic test may be of undoubted value.

4. Be on your guard against self-inflicted skin lesions.

5. Cancer of the skin may follow a single trauma.

6. Sporotrichosis is best diagnosed by culture, taking material from a closed lesion.

References:

1. CLEMENT SIMON: Questions actuelles de Syphiligraphie. Legrand, editeur, Paris, 1926.

2. BARTHELEMY: La syphilis post-traumatique. *Arch. Dermat. syphili. de la clinique de l'Hospital Saint-Louis,* I, 277-307, 1929.

3. KLAUDER: Syphilis and trauma, *J.A.M.A.* 78, 1029-1037, 1922.

4. ELIET: Contribution a l'etude de la syphilis traumatique. These de Paris, 1926.

5. OLIVER LENOIR: Conference sur les accidents du travail. I vol., Vogot editeur, Paris, 1913.

DR. DONALD JOHNSON, Fairmont, Minn.: I would like to bring up a matter which Dr. Beeson mentioned but did not discuss in detail. This is a subject which has been the cause of great distress among medical men, that is, the question of regional herpes. To illustrate with a case: a child of about eight years has had, with uncanny regularity since the age of two, a herpes occurring on the left side of the midline at the point of the chin. The recurrence takes place about every six weeks. The Germans have done considerable work on herpes of this type and have discovered that there are inclusional bodies from the discharge of the herpes lesion which are extremely similar to the inclusional bodies found in the lesions of smallpox, and therefore they are vaccinating such cases with smallpox vaccine. I would like to hear from Dr. Beeson about this. My case is extremely resistant to treatment.

DR. B. BARKER BEESON, (closing): I might say that I do not know much about herpes. I have heard it said that it is sometimes hard to differentiate between herpes zoster and herpes simplex. The idea is rather prevalent that herpes is not recurrent, but cases have been reported. The problem of recurrent herpes is one that would try almost any one's patience. I have seen two cases cured by repeated injections of their own blood, which is supposed to be a desensitizing agent. I do not offer this as a cure. In regard to potassium iodide, in late cases it is valuable. I recall a method gotten out by the late Sanger Brown, which consisted in adding an ounce of potassium iodide to a gallon of water and having the patient drink this in the course of 24 hours. I recall that in trying it in several cases of tertiary syphilis I do not think the patients ever finished more than one gallon. Fournier, the authority on syphilis the world over, thought one could get as good results with 60 grains of potassium iodide divided into three or four doses as from single very large doses. It is well to start with small doses and increase gradually. Some people show sensitiveness to this drug, but in the late cases, such as I showed here, it seems to have some value.

Midwest Safety Conference

Abstracts of Occupational Disease and Safety Equipment Sessions

THE 14th Annual Midwest Safety Conference convened at The Stevens Hotel, Chicago, May 5, 6, and 7, 1936.

Of particular interest to industrial physicians and surgeons were the Occupational Disease Session and the Safety Equipment Session, both on Thursday, May 7, 1936.

At 9:30 a.m., the Occupational Disease Session included a talk by M. I. DORFAN, Manager of the Dust Collecting Division, Blaw-Knox Company, Pittsburgh, Penna., on the subject "Eliminating Occupational Disease Hazards Through Ventilation," after which DR. R. R. SAYERS, Director of the Industrial Hygiene Bureau, U. S. Public Health Service, Washington, D. C., talked on "What the Industrial Executive Should Know About Occupational Diseases." C. S. CRAIGMILE, Vice-President of the Belden Mfg. Co. presided at this session.

At 2:00 p.m., the Safety Equipment Session included a talk by DR. C. O. SAPPINGTON, Consulting Industrial Hygienist, of Chicago, on "The Proper Type, Use and Maintenance of Respiratory Protective Devices," the Seventh Inning Stretch—a Musical Interlude, led by E. L. WHEELER, and a Roving Broadcast, in which inquiries were made about safety shoes and foot protection; eye protection; protective clothing; gas detection and ventilation; welding; ladders; and salt. The chairman at this session was P. J. BRAND, Director of Safety, Pullman-Standard Car Mfg. Co., of Chicago.

MR. DORFAN, in speaking about "Eliminating Occupational Disease Hazards Through Ventilation," recognized that this is a tremendously broad field. He showed a number of lantern slides which gave data relative to systems, types, and devices for dust collection, and graphs from

the behavior of dust under various conditions. In his discussion in answer to questions, Mr. Dorfan indicated that, in a number of instances, it was not possible to give "cut and dried" answers to a great many problems, but it was necessary first to study these problems separately, learn the distinguishing characteristics, and apply specific measures to them in solution.

DR. SAYERS, in discussing "What an Industrial Executive Should Know about Occupational Diseases," stated that there were about 15 million people concerned in this question. Industrial hygiene was defined as a branch of preventive medicine having to do with the protection of the health of workers. In finding out whether there is an occupational disease problem, one should understand whether there is a higher incidence of disease among any given group of employees than in the general population, as to where, when and how this incidence occurs. Already there has been a great deal of progress in the control of occupational disease, but there is still much to be done in certain types of manufacturing. It is believed desirable to arouse the health interest in employees, thus providing an intelligent basis for cooperation. In this country there are possibly 40 organizations interested in industrial hygiene, and it is possible to secure from these a great deal of valuable information for the employer. In attacking this question, one may first collect morbidity and mortality statistics and compare these with those in the general population. However, it is very difficult to get actual rates of death, and of course it is almost impossible to get morbidity statistics which are of any value because of the insufficiency of reporting. Reference was made to Dublin's figures on life expectancy, comparing the expectancy of the industrial worker with that of the person in the general population. Sickness records in plants are of great value, and reference was made particularly to the work of the U. S. Public Health Service in gathering statistics on the rates of disease in different industries and the value of these records. Information is now being collected on approximately 600,000 persons by occupation and by industry, and these figures will be of great value in establishing normal standards, if they can be called such. Another important method of studying the occupational disease situation in any given industry is the use of preliminary surveys of the engineering type similar to surveys which were made by the Public Health Service. It should be definitely understood that these surveys, which are extensive inspections, do not include any data regarding the actual exposure, and one should never confuse inspection with exposure measurements. In addition to this method, there is also the method of engineering and medical surveys which includes sanitary surveys, occupational analyses, and the necessary physical examinations, all of this information being properly correlated with interpretation as to its relationship and significance. It is assumed of course that whatever laboratory work is necessary in conjunction with examinations will be done. There are a number of remedies for the control of occupational disease hazards: isolation of process; enclosure of process; use of local exhaust systems; wet methods; substitution of less toxic or non-toxic materials; use of personal respiratory protective equipment, which is somewhat limited; cleanliness; proper clothing, and others too numerous to mention. It is quite likely that the compensation laws will stimulate the necessity of knowing what, where, when, and how occupational diseases occur in various types of industries.

Finally, it should never be forgotten that prevention is a very important aspect of this whole problem.

IN THE afternoon of Thursday, May 7, at the Safety Equipment Session, DR. C. O. SAPPINGTON talked on "The Proper Type, Use and Maintenance of Respiratory Protective Devices." The speaker first considered the general requirements of all respiratory protective equipment and then showed lantern slides giving an outline by Brown, of the U. S. Bureau of Mines, of a classification of the different types of protective apparatus. Each type was exhibited on a lantern slide and its uses, limitations, and maintenance commented upon. Among the different types of devices considered were oxygen breathing apparatus, hose masks, airline respirators, abrasive blasting respirators, air purifiers, chemical filter respirators or gas masks, chemical cartridge respirators, mechanical filter or dust respirators, and non-approved dust respirators. Time was also given to the discussion of the participation of the employer, the safety equipment manufacturer, and the employee, in educational programs relating to the proper use of protective apparatus, and also the necessity of using a well developed program designed to secure intelligent cooperation on the part of employees. It is expected that great improvement will be made in some types of respiratory protective apparatus in the future. Although protection of various kinds is necessary under different conditions, Dr. Sappington laid great stress on realizing that in these problems one must always be dealing with the human factor, an item which he long ago recognized as being important in health and safety work.

As a feature of the Midwest Safety Conference, the Safety Exhibit contained the latest developments in methods of protection. The exhibitors were the following: Aetna Casualty, Surety and Affiliated Companies; American LaFrance Foamite Industries, Inc.; American Optical Co.; American Red Cross; Black, Sivalls & Bryson, Inc.; Brown Shoe Co.; R. H. Buhrke Co.; H. D. Bullard Co.; Chicago Eye Shield Co.; Davis Emergency Equipment Co. Inc.; C. H. Dockson Co.; Duke Laboratories, Inc.; Holcomb Safety Garment Co.; Hynson, Westcott & Dunning, Inc.; International Shoe Co.; Justrite Mfg. Co.; Walter Kidde & Co.; Lehigh Safety Shoe Co., Inc.; Liberty Mutual Insurance Co.; Martindale Electric Co.; Melflex Products Co.; Metropolitan Life Insurance Co.; Mine Safety Appliances Co.; National Safety Council; Patent Scaffolding Co.; Phister Mfg. Co.; Protective Equipment, Inc.; Protectoseal Co.; Pyrene Mfg. Co.; Safety Equipment Service Co.; Safety First Shoe Co.; Shepherd Safety Shoe Corp.; Standard Safety Equipment Co.; Travelers Insurance Co.; U. S. Department of Labor; Williams Jewelry & Mfg. Co.

Injuries of the Kidney

—*With Remarks on the Effects of Trauma in General on Urinary Infection and Stone Formation*—

by

VINCENT J. O'CONOR, M.D., F.A.C.S.,
Chicago

THE relative infrequency of kidney injury is undoubtedly due to the renal mobility and to its well protected location in the retroperitoneal position.* In an active hospital experience of 15 years we have tabulated only 39 instances of gross clinical renal injury from external violence,—this in hospitals caring for many industrial accident patients and situated in metropolitan areas where, unfortunately, many automobile accidents occur. Renal injuries associated with more or less extensive involvement of other internal organs are not included in this report. All of these patients died of shock and other complications and did not present the urological problem of renal injury.

Etiology

KUSTER, in 1896, first reported an experimental and clinical study of the mechanism of ruptured kidney by external violence. The kidney acts as a ball of fluid and the impact is transmitted in all directions. The traumatic force is conveyed (a) either from the front, from the side, or from behind as in a direct blow, or a fall, or from a crushing force; such force may operate directly through the abdominal wall, or cause the kidney to be forced against the lower ribs or against the resistant spinous processes. This was the more common type of injury in our experience. Injury of the kidney may also occur by (b) indirect force after falls on the buttocks or feet, and in these instances was probably associated with sudden contraction of the abdominal muscles. Four of our patients suffered this type of injury. Injury by (c) muscular action alone is attributed to sudden contraction of the diaphragm or of the abdominal muscles, as in lifting a heavy weight or in abrupt flexion of the body. None of our patients was found to comply with this supposed etiology.

It is well known that a pathologic kidney is more susceptible to injury by external force than is a normal kidney. This is illustrated in our series in that four of these kidneys were markedly hydronephrotic, two contained large calculi, and one was the seat of an advanced hypernephroma. Fifteen of these patients suffered industrial accidents, and falls of some sort accounted for the injury in every one of these instances. Falling into excavations, from railway cars, across or from scaffolding, over fences, etc., are all listed as direct causes. Two patients suffered the injury by falling upon the edge of a metal bucket. Five patients were injured in play at sports: four in football games, and one at baseball (i.e., sliding for base). Fifteen were injured in automobile accidents, four of which were of a crushing nature (i.e., two were caught between moving cars, and two between the car and a wall). Two patients were partially crushed between railway cars. Two penetrations from gunshot wounds are included. Fracture of one or more ribs occurred in six patients, and arm or leg fractures in five. In none of our cases was there a fracture of the spine or of the pelvis.

All cases of renal injury bear careful watching to determine the type and extent of injury and the well considered decision as to whether treatment should be conservative and expectant or immediate operative intervention. In this regard it should be emphasized that the extent of the external injury in no way determines the severity of kidney damage. Hematuria is the prominent symptom of renal injury. It occurred in 37 of our cases. In the other two included in this report a sizable perirenal hematoma developed without gross hematuria at any time. The duration of hematuria varied from three to 19 days. Pain in the loin and back was present in all cases, varying from a mild ache to intense pain, and requiring repeated sedatives. Here again, in our experience, pain was not an important criterion as to the extent of renal damage or of the degree of hemorrhage. Shock, as evidenced by the general appearance and condition of the patient, with emphasis on the blood pressure level (especially the pulse pressure), gives the important immediate clinical picture. If severe hematuria continues, repeated blood counts indicate the degree of secondary anemia. An increasingly palpable tumor in the loin may indicate continued perirenal bleeding, but even in the presence of continued hemorrhage and an increasing anemia we maintain a conservative attitude on treatment unless the blood pressure cannot be adequately maintained and unless the appearance of the patient seems to call for emergency measures to stop severe hemorrhage.

In the borderline cases, intravenous urography furnishes us with most important information. This aid was first emphasized by McKenna and later by Mark. Extrarenal extravasation of the dye tells us immediately as to whether we are dealing with an injury in which the pelvis and calices have been ruptured or whether the tear is extra- or intra-capsular in type. Where extrarenal extravasation is demonstrable, if the patient's general condition is immediately satisfactory, conservative and supportive treatment is indicated with the knowledge that a later drainage of the loin must be done but at a time when the patient is in a condition better to stand the procedure. When the patient's condition is critical, immediate exploration of the flank is indicated. Four of our patients were operated upon as an emergency procedure; one patient died from hemorrhage due to pulpification of the kidney and a tear directly across the renal pedicle. Two were nephrectomized and one drained and packed. Five of our patients were operated upon by us from five days to four weeks after injury.

*Presented at a meeting of the Surgical Association of the Chicago, Milwaukee, St. Paul & Pacific Railroad (Lines East), Chicago, November 15, 1935.

In one (a hydronephrotic kidney), nephrectomy was performed; in four, incision and drainage sufficed. None of these patients died. One had a urinary fistula which persisted for 11 weeks and was nephrectomized elsewhere two years later. The patient with an extensive hypernephroma (so diagnosed by us) was refused operation 12 weeks after injury although he had apparently recovered from the direct effects of the injury. He was operated upon elsewhere, and died on the operating table from uncontrollable hemorrhage.

Our experience coincides with those who advocate careful conservative treatment in most cases of renal injury. The rare extensive lesion calls for immediate surgery and the indications are clear. Continued shock, narrowing pulse pressure, signs of continued internal or urinary hemorrhage of a severe degree which do not respond to intravenous glucose and saline infusions or blood transfusion, and supported by excretory urographic evidence of extensive injury, constitute the indication for operative intervention. In the real emergency one must not even delay for roentgenographic findings. But in the main, careful consideration with adequate supportive treatment will be rewarded by the survival of the patient.

We feel that it is most important to keep these patients at complete rest in bed for at least two weeks after the cessation of hematuria. Two of our patients who could not be so controlled had a recurrence of massive bleeding eight and 12 days respectively after their departure from the hospital. In one of these patients operative intervention was considered on the second admission, but both recovered on conservative treatment after spending an additional three weeks at rest.

Rolnick reports a case where an emergency nephrectomy was performed to save the life of a patient injured five weeks before and where a transient hematuria had been present for only 24 hours at the time of the original injury. He explains this unusual case by stating that at the time of injury there was only a slight subcapsular tear. Continued activity for the next five weeks, together with automobile riding and carrying a heavy sample case, completed the renal tear and brought about the severe later hemorrhage.

Of the 29 cases treated conservatively throughout, none died and we have no record that their condition necessitated subsequent treatment elsewhere. This latter, however, is no proof that they may not develop obstructive pathology as a result of constricting bands or adhesions at a later date. We have removed four very large hydronephrotic kidneys where there was a prior history of renal injury with hematuria many years before we saw them. Whether the hydronephrosis existed prior to the injury or developed as a result of it we could not ascertain from a study of the specimens removed.

Before leaving this subject we wish to emphasize another consideration of "ruptured kidney." Lawyers for the plaintiff in personal injury suits have recently discovered that many clients suffer supposed renal injury and that this claim is like that of unexplainable backache in that it is hard to convince a jury that injury has not occurred, even in the presence of completely normal urologic findings. Our medical brethren, in sympathy with and in support of the supposedly injured client, have not been adverse to depicting before the jury a normal renal calyx outline as the area of prior rupture. We emphasize this new interest in renal injury so that in fairness to all concerned the examining surgeon may note carefully the character of the urine and associated findings during the early observation of these injured patients. These notations might clarify the validity of these claims when the matter becomes a medicolegal one many weeks later.

Traumatic Dislocation of the Kidney

DURING the past 15 years we have studied more than 200 patients with movable kidney by modern urologic methods. The histories, clinical findings and roentgenologic data in 42 of these patients indicated the advisability of surgical intervention for fixation of the kidney and freeing of the ureter. Twelve of these patients dated the onset and course of their trouble so intimately with mechanical injury, and the operative findings so closely tallied with this supposition, that we have classed them as traumatic in origin. We cannot, of course, overlook the fact that in these individuals there were undoubtedly predisposing factors which made traumatic dislocation of the kidney possible.

This traumatic loosening of the kidney may be due to a slow, gradual loosening of its attachments, but is more often caused by a sudden rupture of its fascial and peritoneal covering. Small areas of perirenal and peri-ureteral hemorrhage occur, and the resultant organization about these areas may result in sclerotic attachments which compress or angulate the ureter or renal pelvis. If low grade infection supervenes in these areas of extravasation, the subsequent density of these cicatrices will be increased and there will be a gradual compression of kidney, renal pelvis or ureter. If the kidney is not displaced and the trauma affects only the perirenal tissue, a subsequent perirenal sclerosis may result. We have reported four such cases relieved by operative removal of this fibrolipomatous encasement about the kidney. In three of these there was a definite history of renal trauma several years before the onset of symptoms.

Following this type of renal trauma the pain and urinary stasis which results is not so much the result of abnormal renal mobility alone as from the fact that the ureter becomes adherent to the posterior peritoneum, and angulation and rotation occur because of the ureteral wall fixation. This fact makes it imperative that the kidney, renal pelvis and ureter be thoroughly freed from all abnormal surrounding attachments before nephropexy is accomplished.

In the case of the ureter it should be freed down to the level of the bifurcation of the iliac vessels, as we have most often found the areas of fixation to be between the middle third of the ureter and the posterior peritoneum. We do not wish to foster an undue enthusiasm for the operation of kidney fixation, as it has been an unwarranted procedure in many patients in the past. The operation, however, has definite indications in carefully studied and properly selected cases. In 1928 we reported for the first time a roentgenographic follow-up on 22 of these patients, all of whom had been operated upon from four to eight years previously. All were symptom-free, and

the emptying time of the renal pelvis had returned to normal. We firmly believe that trauma plays an important part in renal dysfunction in this type of case—not so much in the degree of renal displacement as in the extent of perireteral and peripelvic sclerosis which, together with the renal ptosis, causes obstruction of the free outflow of urine.

Effect on Urinary Tract of Trauma

IN FRACTURE or injury of the spine with resultant bladder paralysis, it is well known the rapidity with which urinary infection sets in, especially after repeated catheterization. It should be further emphasized that in all these patients an alkaline lime splitting infection rapidly produces concretions or stones in the renal pelvis and bladder. We will not take up the discussion of the proper method of handling the bladder in these patients except to state that after attempting (1) internal catheterization, (2) indwelling ureteral catheter, (3) leaving them alone to the development of a paradoxical incontinence, we have finally experienced better results with (4) immediate suprapubic cystostomy. For many years we have noted the frequency with which patients recovering from a prolonged immobilization in the treatment of fractures or osteomyelitis tend to develop pyelitis, cystitis and renal stone formation. In the light of our present knowledge we now consider these complications to be due to a disturbed calcium metabolism associated with a chronically alkaline urine favoring the development of phosphatic stones. Unfortunately, we did not keep records of our earlier cases of stone formation associated with fractures. But during the past five years we have tabulated 19 patients in whom stone formation appeared after or during the healing period associated with fractures other than those of the spine. In every one the routine urinalyses showed these patients to have an alkaline urine. None of these individuals had had previous symptoms suggestive of renal stone, and in 10 the renal regions were included in prior x-rays and showed no shadows suggestive of stone.

In the light of these observations we suggest that these patients be placed upon a high vitamin A, acid ash diet during their convalescence from fracture or osteomyelitis. If the urine does not remain distinctly acid during this time, acidulating drugs should be added so that the hydrogen on concentration is maintained below 5.2, as it has been definitely shown that this type of stone will not form at this point of urine acidulation. Cod liver oil, haliver oil and fresh yeast are added to diet to avoid deficiency in vitamin A consumption and to prevent the hyalinization of the renal pelvis which has been shown to occur in these cases.

Occupational Diseases

THE plaintiff in the course of his employment in the defendant's chemical plant was exposed to dust incident to the manufacture of zinc stearate dusting powder.* Attributing a combined sclerosis from which he subsequently suffered to the inhalations of zinc stearate dust, he sued his employer. The trial court overruled the defendant's demurrer to the evidence and entered judgment for the plaintiff.

On appeal, the Supreme Court of Missouri said that the question to be determined was whether there was evidence tending to prove that combined sclerosis — a degenerative process of the spinal cord—from which the experts testified that the plaintiff was suffering was an occupational disease under the Missouri occupational disease act. An occupational disease, said the court, within the meaning of the act, as well as at common law, is one that is "peculiar" or "incident" to the work or process carried on. "Such a disease is defined to be a disease contracted in the usual and ordinary course of events, which, from the common experience of humanity, is known to be incidental to a particular employment. It ordinarily results from long-continued work in the particular employment." *Lowell* v *Williams Bros.* (Mo. App.) 50 S.W. (2d) 710. In the case here abstracted, the plaintiff testified that he was in good health when he went to work for the defendant. During the last six months of his employment he was engaged in making zinc stearate dusting powder. He coughed a great deal, "emitting white stuff 'like talcum powder.'" His throat and lungs were sore, his arms hurt, and his hands "were without feeling." His stomach became swollen and he could eat very little. He walked with difficulty and after he left the defendant's employment, he could not move for a time. He was in a hospital twice for treatment and, according to the medical testimony, while there he was treated for locomotor ataxia. A physician specializing in mental and nervous diseases, called by the plaintiff, testified that the plaintiff was suffering from a nervous disorder consisting of a degeneration of the posterior columns of the spinal cord and known as combined sclerosis, which "could be due to absorption of zinc." He further testified, however, that he had never had a patient who had contracted combined sclerosis from zinc poisoning and did not know what amount of exposure or absorption would be necessary to produce the condition. He further testified that certain abnormalities which he found in the plaintiff and on which he rested his opinion that the plaintiff had combined sclerosis were cardinal symptoms of locomotor ataxia, such as an absence of the knee jerks, slight reaction of the pupils to light, and an ataxic gait. Another specialist in mental and nervous diseases testified that the plaintiff was suffering from combined sclerosis but did not definitely attribute the condition to any particular cause. Medical witnesses testifying for the defendant denied that the plaintiff had combined sclerosis and attributed his condition to locomotor ataxia.

In reviewing the evidence, the Supreme Court could find no testimony to the effect that combined sclerosis is an illness or disease peculiar or incident to the work or process carried on. In substantiation of this conclusion drawn from the evidence, the court pointed out that in the report of the Committee on Standard Practices in the Problem of Compensation of Occupational Diseases, of the Industrial Hygiene Section of the American Public Health Association (1931), containing a history of the extension of the workmen's compensation laws to include occupational diseases, there are many schedules of occupational diseases, but combined sclerosis is not listed in any schedule of any state.

* *Wolf* v *Mallinckrodt Chemical Works* (Mo.), 81 S.W. (2d) 323; *J.A.M.A.*, 105:1939, (December7), 1935.

Industrial Medicine

The Journal of Traumatic Surgery and Occupational Diseases

Published Monthly

For the Physician and Surgeon in Industry

Publication Offices

413 Pleasant Street, Beloit, Wis.

Editorial Offices

844 Rush Street, Chicago, Ill.

EDITORS:

JAMES T. CASE, M.D., F.A.C.S.
VOLNEY S. CHENEY, M.D., F.A.C.S.
GEO. G. DAVIS, M.D., F.A.C.S.
JOSEPH JORDAN ELLER, M.D.
HART E. FISHER, M.D., F.A.C.S.
JOHN G. FROST, M.D., F.A.C.S.
OTTO P. GEIER, M.D.
LEROY P. KUHN, M.D., F.A.C.S.
WILLIS W. LASHER, M.D., F.A.C.S.
HORACE W. PORTER, M.D.
FREDERICK W. SLOBE, M.D., F.A.C.S.
CHARLES D. SQUIRES, M.D.

CONSULTANT:
C. O. SAPPINGTON, M.D., DR.P.H.

ASSISTANT EDITOR:
FRANK C. LEWIS, M.D.

MANAGING EDITOR:
A. D. CLOUD

VOLUME 5 MAY, 1936 NUMBER 5

This Issue and the Next

THE MICHIGAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, and the ASSOCIATION OF SURGEONS OF THE NEW YORK CENTRAL SYSTEM have selected INDUSTRIAL MEDICINE as their official publication. And two new names have been added to our Editorial Board, and one new one to our editorial personnel. The former are WILLIS W. LASHER, M.D., F.A.C.S., of New York City, already well known to the field of industrial medicine and surgery not only as a Chief Surgeon, but also for his interesting and important contributions to the literature, and HORACE W. PORTER, M.D., of Jackson, Mich., active in the work of the Michigan Association, Secretary of the Jackson County Medical Society, and Editor of its monthly bulletin. And the latter is FRANK C. LEWIS, M.D., long identified with the *International Journal of Medicine and Surgery,* who joins our organization as Assistant Editor, and Eastern Representative with headquarters in New York City.

The U. S. Labor Department's committees on silicosis (p. 222) start off with comprehensive names. There being no cure but prevention, the technical committees are formed for prevention through medical control and engineering control. The medical committee, under the chairmanship of DR. R. R. SAYERS, is well selected. Even Congressman Marcantonio, of Guffey Bridge publicity, must admit that these "are all, all honorable men." . . .

DR. HAZLETT, in his "Medical-Engineering Control of Industrial Health Hazards" (p. 232), is rather temperate in his characterization of a situation which a good many employers are unable even to think of in mild terms. He says: "The result has been a great galaxy of diseases, some of which are definitely from an industrial source while others, notwithstanding they are common to the race, are being classified as 'occupational.'" . . .

DR. GEO. G. DAVIS has long been interested in "Gas Bacillus Infections," and his thorough-going discussion of the subject, beginning on p. 234, brings it right up to date . . .

Possibly DR. C. O. SAPPINGTON, in his review of the new edition of "Preventive Medicine and Hygiene." (p. 255), is not as emphatic as we would like him to be in calling attention to DR. ROSENAU'S mention of the establishment of INDUSTRIAL MEDICINE in 1932 as an event of importance in the history of industrial medicine and surgery . . .

This is the convention season, and so we present a listener's abstract of each of the papers given at the sixteenth annual meeting of the Medical and Surgical Section of the Association of American Railroads on May 11-12 (p. 251); the industrial medicine sessions of the American Medical Association's eighty-seventh convention, at Kansas City, on May 13; and the occupational disease and safety equipment sessions of the Midwest Safety Conference, on May 7. There is also a short account, by DR. PORTER, of the spring meeting of the Michigan Association of Industrial Physicians and Surgeons, on May 6 (p. 223), and the program of the annual meeting of the Central States Society of Industrial Medicine and Surgery, on May 19—the latter to be reported in the June issue . . .

The able, and rather unusual study of "Clinical Aspects of Silicosis," by Dr. Ross K. CHILDERHOSE (p. 224), was the feature of the evening session of the Michigan Association's meeting . . .

Injuries are present in this issue in numbers, as it were — DR. OWEN H. WANGENSTEEN makes a scholarly and very interesting presentation on "Abdominal Injuries" (p. 268) DR. VINCENT J. O'CONOR deals with "Injuries of the Kidney" (p. 244); and DR. M. T. KOVEN has an authoritative article on "Traumatic Derangements About the Ankle Joint" (p. 227).

DR. B. BARKER BEESON tells of "Dermatology Related to Trauma," (p. 263), with reference to "three disorders whose lesions may appear upon the skin following an injury." And "the first and most important" of these is syphilis. He follows with a short discussion of the so-called "professional cancers," and then gives a paragraph to traumatic herpes zoster . . .

DR. ROBERT T. LEGGE, Professor of Hygiene, University of California, and University Physician, has made the history of industrial medicine his hobby for many years. In 1933, the first two chapters of his "History" were published in INDUSTRIAL MEDICINE, under the titles "Occupations of Antiquity," and "The History of Industrial Medicine"; and in 1934, the third chapter, "Modern Industrial Medicine." With INDUSTRIAL MEDICINE for June, 1936, we begin the serial publication of the remainder of the book . . .

And the June issue will present also "The Industrial Medical Department: A Study of Its Organization, Based on a Review of 20,919 Consecutive Accident Cases in Three Years," by DR. WILLIS W. LASHER.

Industrial Medicine and Surgery

Shall We Promote Industrial Health and Efficiency or Only Industrial Safety?

THE results achieved by American industry during the past quarter-century in the field of accident prevention have been of phenomenal significance.* Experience analyzed by the U. S. Bureau of Labor Statistics in 1929 showed the following remarkable achievements for certain large groups of industries affiliated with the National Safety Council. The data are in all instances expressed in terms of accident severity rates per 1000 man-hours.

The power press industries effected a reduction in time lost as a result of accidents of 33% in one year.

The chemical industries made a similar saving of 60% in four years.

The paper mills showed a reduction of 40% in seven years.

The Portland Cement Association, a reduction of 49% in eight years.

The iron and steel industries cut their figure by 56% in 17 years.

The safety movement has thus justified itself in a most striking and dramatic fashion and has become firmly established as a vital part of American industry.

This achievement gives just cause for gratification to all who have been concerned with the evolving program and, particularly, to the Safety Council which, from the first, has been its wise and far-sighted leader.

To some of us, however, it has long appeared that the aroused social conscience, the intelligent self-interest and the excellent practical techniques which have characterized the safety movement might well be utilized for wider ends. We have felt that the health and efficiency of the worker was of far greater significance to industry than his freedom from mechanical injury; and that the same social conscience, the same intelligent self-interest, the same practical techniques which have brought such notable results in the narrow field of safety should be applied over a wider area.

Such an ideal was in the minds of the leaders of the Council when it appointed a Vice-President for Health, an office I had the honor of holding for some years; when it created a health division in the headquarters office at Chicago; and when it sponsored such special studies as those of the Committees on Benzol Poisoning, on Spray Coating and on Sand Blasting. Such an ideal has actuated individual firms here and there to establish machinery for the study and control of industrial disease similar to the machinery now used to prevent industrial accidents. Yet the idea has never really taken hold throughout the country; and when the Safety Council was pressed for funds, the Industrial Health Division was the first to be sacrificed. It seems abundantly clear that the Council and the industries it represents are not really convinced that it is as important to promote industrial health and efficiency as to safeguard industrial safety.

In considering this question I have often wondered what has prevented a whole-hearted acceptance of the concept of industrial health as a reasonable—and indeed an essential—objective of industry. It seemed to me that this concept rests on three assumptions which may be stated as follows and which are easily susceptible of proof:

1. That disease and handicaps among industrial workers, related to causes other than accidental injuries, are quantitatively important.

2. That such diseases and handicaps are of direct economic significance to the employer of labor in several different ways.

3. That such diseases and handicaps can in large measure be controlled by relatively simple and economical means.

If these three premises are accepted, it seems to me that the argument for a real health program for industry is a clear and convincing one; and I should like, very briefly, to address myself to each basic assumption in turn.

First of all, then, how important are accidents and diseases, respectively, as causes of disability and death among industrial workers?

From the standpoint of mortality, a recent study of Death Rates by Occupation prepared by Miss Jessamine Whitney of the National Tuberculosis Association is of considerable significance. She finds that the death rate for occupied males from all causes (corrected for variation in age) rises from 623 per 10,000 for agricultural workers to 775 for clerical workers, to 829 for skilled industrial workers, to 1009 for semi-skilled industrial workers and to 1448 for unskilled labor. Mortality due to all forms of accidents rises from 15 per 100,000 among agricultural workers to 51 per 10,000 among the unskilled industrial workers, an increase of 240%; but pulmonary tuberculosis rises from 47 for the agricultural workers to 185 for the unskilled industrial workers, an increase of 294%.

Perhaps the most illuminating comparison may be obtained by ignoring the agricultural workers, with their very low rates and contrasting the clerical group as a whole with the combined industrial group, including skilled, semi-skilled and unskilled workers. The mortality rates of the industrial workers as a whole for all causes of death exceed those of the clerical workers by 230 per 100,000, which means that in every 100,000 industrial workers there occur (at corresponding ages) 320 more deaths than among 100,000 clerical workers. Of this excess of 320 deaths per 100,000 20 deaths only are due to accidents of all kinds, 38 are due to pneumonia and 54 to pulmonary tuberculosis. Thus, an excess of accidents accounts for only one sixteenth of the total excess death rate of the industrial workers while an excess of pneumonia is nearly twice as important and an excess of tuberculosis nearly three times as important.

It is not, of course, for a moment intended to imply that this total excess of mortality among industrial workers is entirely due to hazards of industry. Social and economic conditions, racial habits, individual personal handicaps, physical, mental and emotional, all play a part. The direct influence of industrial conditions is, however, relatively, probably just as great in pneumonia and in tuberculosis as in accidents. The main point I wish to make is this, and it is, I think, a point which answers the first of the three questions formulated above.

Diseases and handicaps place a very severe excess burden of disability and death upon industrial workers, as compared with other sections of the population; and among these diseases and handicaps those related to accidental injuries form a very small part—certainly less than one tenth and more nearly one twentieth of the total.

Our next question is whether such non-accidental diseases and handicaps are of direct economic concern to the industrialist; and here, too, the answer must be in the affirmative. There are at least three different ways in which these illnesses affect the dividends of any business.

In the first place, a certain very substantial proportion of the diseases from which the workers suffer are directly traceable to industrial causes and are therefore compensable in some states and offer opportunities for costly damage suits in others. There are some 94 different groups of industrial poisons recognized in the United States, associated with about 900 different occupations. Lead poisoning, carbon monoxide and benzol are perhaps the most menacing of these poisonings. From a quantitative standpoint, however, the various forms of occupational dermatitis are of prime significance. Since the first case of this kind was recognized in America in 1712, the hazard has increased so that it is estimated by Dr. C. C. Lane of Boston that there occur some 50,000 such poisonings in the United States every year. In a recent series of occupational skin diseases in New York disability extended for more than a year in 24% of the cases.

The respiratory diseases, including silicosis and industrial tuberculosis are of even great importance than the poisonings; and pneumonia may in many instances be directly related to occupational hazards of chilling and exposure. The most significant figures on this point are to be found in the occupational statistics of the Registrar-General of England and Wales. In the last Decennial Report of this office data are given for about 200 different occupations. Of these occupations there are six, only, which show a mortality rate from all causes of 80% or more above the normal. Five of the six are occupations involving exposure to silica dust (earthenware makers, 83% above, file-makers, 85% above, metal grinders, 98% above, tin and copper miners, 125% above, cutlery workers,

* C. E. A. WINSLOW, Professor of Public Health, Yale University School of Medicine, at the Greater New York Safety Conference, March 3-5, 1936; published in *The Industrial Bulletin, State of New York Department of Labor*, April, 1936.

Michigan Association of Industrial Physicians and Surgeons

Officers

PRESIDENT ..... A. H. WHITTAKER, M.D., F.A.C.S. Detroit

VICE-PRESIDENT ..... LEON SEVEY, M.D. Grand Rapids

SECRETARY-TREASURER ..... DON F. KUDNER, M.D., F.A.C.S. Jackson

Board of Directors

L. H. CHILDS, M.D. ..... Flint
CARL E. BADGELY, M.D., F.A.C.S. ..... Ann Arbor
HENRY J. PYLE, M.D. ..... Grand Rapids

130% above). There can be no doubt that these tremendous excess death rates are almost wholly due to the hazard of industrial dusts. The recent revelations with regard to silicosis among tunnel workers in West Virginia have merely attracted wider attention to a problem whose acuteness has been recognized by experts for many years.

Quite aside from the problems of compensation costs or damage suits, however, disease among industrial workers is of fundamental importance to the industrialist. Absenteeism and labor turnover are definite and important items in production costs which deserve serious attention. Even if the illnesses concerned are in no way caused by industrial conditions, their control may often bring in revenue many times in excess of the cost of a preventive program.

Finally, even the worker who is actually at the bench may, under certain circumstances be operating at a markedly low level of efficiency because of his physical status or because of the environmental conditions under which the work is performed. To maintain productive efficiency as well as to avoid damage suits and the burden of absenteeism and labor turnover, the employer has a vital economic interest in the health as well as the safety of the employee.

Granting, then, that large groups of industrial workers do suffer from an unduly high burden of physical disability and that this fact is of serious concern to the industrialist, we come to our third question—whether this disability (when not due to mechanical accidents) can be effectively controlled. The work performed by the United States Public Health Service during the past 20 years gives us a clear answer to this problem.[1] Again and again, it has been possible by expert study to locate the exact cause of a health menace.

Thus, in the steel industry, high pneumonia rates have long attracted attention. It has now been shown that the hazard is chiefly localized in certain groups of workers, where the pneumonia rate is actually eight or 10 times the normal and that it is directly associated with heat and wide changes in temperature, irritant and toxic gases, dusts, heavy labor and exposure to weather. Often the exact limits of safety have been defined, as in anthracite coal mining where even after long periods of years workers exposed to 10 million particles of dust (of a certain silica content) per cubic feet of air showed practically no silicosis while of those workers exposed to 80 million particles about one-third had the disease. In a storage battery plant, exposure to one milligram of lead per 10 cubic meters of air caused a maximum monthly rate of plumbism compensation cases of .2 per 100 against a rate of 44.0 per 100 for 120 milligrams.

A study of health hazards associated with chromium plating led to the determination of one milligram of chromic acid per 10 cubic meters of air as an upper limit of safety, and to the design of plating tanks and exhaust ventilation which would keep the concentration in the workroom air below this level. In nearly every instance of industrial hazard, there are practical and effective methods of control available to the manufacturer who desires to apply them.

The possibilities of economic saving to industry by an intelligent application of the principles of hygiene are by no means, however, limited to the avoidance of compensation or damage costs. Far below the threshold at which actual damage to health may ensue, relatively slight variations in environmental conditions materially affect human health and efficiency and, in so far, control production. The studies of the New York Commission on Ventilation showed a reduction of 15% in the amount of physical work performed at a temperature of 75° as compared with one of 68°. Vernon in England presented data in regard to one of the tin plate industries which indicated a gain of about 10% in actual output as a result of the installation of air-conditioning equipment. Numerous experiences of a similar kind have indicated the value of improved illumination. In a buffing shop at Schenectady a new lighting equipment increased production 8½%, the additional cost of new lighting amounted to less than half of 1% of the increased production. In a steel machine shop in Chicago, an additional lighting cost amounting to less than 2% of the payroll produced an increase in production of 10%.

It is a recognition of such facts as these that has led to a far-reaching development of an interest in industrial hygiene on the part of certain departments of health as well as of departments of labor and industry. Connecticut has long had a Bureau of Industrial Hygiene in its State Health Department, and West Virginia, North Carolina, Kansas, Missouri, Pennsylvania, Maryland and Michigan have either recently introduced such bureaus or are planning to do so in the immediate future. Meanwhile departments of labor are strengthening their technical staffs to provide aid along similar lines. The recent appointment of Dr. Leonard Greenburg as Executive Director of the Divisions of Industrial Hygiene, New York Sate Department of Labor, should prove of incalculable value to the industries of New York State.

The American Public Health Association is also deeply interested in the question, and the Committee on Administrative Practice, which has done so much in recent years for the development of higher standards in municipal health service, has a special subcommittee working on the development of appraisal standards for industrial health service. Dr. L. D. Bristol, of the American Telephone and Telegraph Company, has prepared a tentative appraisal form which any industry would find invaluable in analyzing its own special problems.

Industry itself, however, has not yet been awakened to the possibilities which lie at its doors, and many a plant which employs highly qualified mechanical experts to supervise its machinery, is operating its human mechanisms under conditions which can only result in waste and inefficiency. To all such industries I would recall the brilliant achievements of the safety movement, and would urge the application of the same general techniques to the even greater problems of industrial health and industrial efficiency.

The "health engineer" should be as essential a factor in production as the safety engineer. He might be a physician who has specialized in industrial hygiene or he might be a public health engineer cooperating with the ordinary plant physician. In either case, it should be his task to make a continuing study of health and efficiency in every department of the industry and to analyze in detail the particular conditions affecting human vitality in each workroom and in each individual process.

Protection against toxic and irritant dusts and fumes, protection against the handling of poisonous substances of various sorts, protection against the hazards of heating and cold and moisture, provision of adequate lighting and ventilation and air conditioning, of a safe water supply and adequate sanitary conveniences—these are a few of the many things with which such a health engineer could concern himself. I am confident that the employment of such

1. See BLOOMFIELD, *A.J.P.H.*, November, 1935, p. 1196.

an expert in any considerable industrial plant would yield a return many times greater than the total cost involved.

Compensation Soothing Syrup

BEFORE the introduction of workmen's compensation in America in 1911,* the treatment of industrial injuries was carried on by private family physicians. The era of industrial medicine had not yet arrived. The man who caught his hand in a machine or sustained a fracture from a fall in a factory was generally sent to his own doctor or to one in whom his employer had confidence.

With the evolution of medical practice and its attendant specialization, the treatment of industrial injuries has fallen into the hands of individuals and groups who have made a speciality of compensation work. This situation has developed from a variety of causes:

In the first place, the employer, who is primarily interested in his compensation costs, insisted on the control of medical service. This he obtained legally by demanding the right to select a physician who was to treat his injured employes.

The other reasons are somewhat more complicated and arose out of a series of factors:

Many were quick to see the financial advantages in compensation work, such as security of cash income, large volume of work, and no necessity for extraordinary qualifications. However, the mass of the administrative work that accompanies compensation practice discouraged a number of physicians from engaging in it.

The necessity for court appearance, plus conferences and disputes with adjusters, insurance companies, employers, and even patients, were also determining factors in sloughing off many eligible practitioners. Furthermore, it was discouraging for well-qualified professional men to find their handiwork ruined by malingering patients and their results subjected to the critical evaluation of apparently less qualified physicians and laymen in official positions.

Eventually, through a process of natural selection, compensation practice became localized in the hands of a minority of the profession. The personalities and experience of these men somehow fitted them particularly for carrying on this work. The compensation physician was looked upon at that time as bordering on the fringe of unethical practice. Many a doctor considered the treatment of compensation cases a shady occupation — almost in the underworld of medical practice.

The passage of time, coupled with the advent of the depression, has forced a reconsideration of previous values. Today, because of improvement in administrative methods and a changing attitude within organized medicine, we find a more wholesome concept of the work.

One of the difficulties which a physician always had to face, and which made him reluctant to undertake the treatment of industrial injuries, lay in the fact that his negotiations, both economic and medical, had to be carried on, for the most part, with a layman, the claim adjuster. These negotiations were frequently distasteful and still are, since the physician often finds himself in a position of being directed in the treatment of a case by a layman. Fortunately, in a number of progressive insurance companies these prerogatives have been assumed by medical men, replacing laymen. A more wholesome relationship has resulted in consequence.

It is in the matter of payment for services that the physician faces his greatest problem in compensation practice.

He may submit a reasonable bill which is acknowledged by the company and paid immediately. Yet another company haggles with him about his fee and arbitrarily cuts it. Instinctively the physician remembers this last company and pads his bill when next he gets a case from it. The company is ultimately the loser and so is the physician since he bids goodbye to his self-respect.

For the past twelve years in New Jersey an attempt has been made to correct this chaotic condition through the medium of medical bills committees, whose purpose it is to arbitrate disputed medical claims. Three counties now have such committees, including Essex County, whose set-up I shall explain here.

The Essex committee is composed of three physicians: one representing the state industrial commission; one, the employers' group; and one the county medical society. The committee is approved by the state commissioner of labor and by the director of the state compensation bureau.

All disputed medical bills are referred to the committee for arbitration, whether they emanate from the industrial commission, insurance companies, employers, or physicians. The committee meets once a month and conducts all its hearings at the Newark Academy of Medicine or at the county medical society building.

In each case the physician and the employer, or the insurance carriers, are present at the hearings. The physician is informed of his obligations as well as of his privileges under the compensation law. At the same time, the insurance carrier is given an adequate hearing as to the reasonableness of the bill.

Here is a typical case, by way of illustration:

Doctor X submits his bill to the insurance company for the treatment of an infected finger. The bill may be large. When the claim adjuster picks up this bill he perhaps misunderstands the nature of the service rendered. He communicates with his home office and is advised to reduce the bill radically. Formerly, the entire negotiations would be carried on between the doctor and the claim adjuster, with considerable bickering, threats, and counter threats, and with wholly unsatisfactory results.

The physician, on the one hand, may have been dealing with an extensive cellulitis and suppurating tenosynovitis, requiring several operations and many months of dressing and rehabilitating treatment. His bill, we'll say, is a justifiable one. On the other hand, the physician may have exaggerated in his own mind the value of his services and the bill may be truly exorbitant.

At all events, the insurance company submits the bill to the medical bills committee. A hearing is called at which the insurance representative and the physician are present. A thorough discussion of the case, the treatment, and the objections to the bill takes place. Then the bill is adjusted—either reduced or sustained, depending upon the facts submitted.

No standard or fixed fees are approved. A flexible, equitable principle has been followed, namely: that the average fee for this type of service shall be that for a person of the social status of the injured in his community. The adjudication seems to be satisfactory to both parties since the insurance company is represented on the board by a qualified physician; at the same time, the physician submitting the bill is generally content with the judgment of his colleagues.

Misunderstandings may arise, but they are eliminated by a frank discussion without any attempt at being arbitrary or dictatorial. Many inexperienced claim adjusters have a notion that every practicing physician must conform to the charges generally approved by his company for those physicians who do a large volume of industrial accident work. Conversely, physicians not familiar with the operation of the law and their obligations under the law are assisted in avoiding difficulties by being fully apprised of their privileges and duties.

This latter educational phase has been supplemented by the frequent talks by members of the same committee before members of the medical society, explaining the operation of the workmen's compensation law, the duties and privileges of physicians, and the operation of the medical bills committee.

This committee in Essex County has now been in operation for the past 12 years, and its unique character may be noted by the fact that it has no actual legal standing. While it is appointed essentially by the county medical society and approved by the state commissioner of labor, its decisions have no judicial standing yet. Nevertheless, its effectiveness has been as great as if it were an arm of the court.

Claim adjusters have cooperated in accepting the adjudications of this committee since they have been for the most part equitable and based on years of experience in these matters.

In fact, so successful has the arrangement proved itself, that the Medical Society of New Jersey contemplates urging its adoption in every county in the state.

* Dr. Henry H. Kessler, in *Med. Economics*, April, 1936.

Arsenic in Human Tissues and in Tobacco

BOOS and Werby find that all hair contains arsenic; that is to say, arsenic determinable by ordinary forensic analysis.* This arsenic is being constantly excreted by the hair, which constitutes an important organ of elimination for this poison, but the expulsion of arsenic by hair

* *M. J. Australia*, Sydney: 2:810, (December 14), 1935; Abstr. *J.A.M.A.* 106: 1046, (March 21), 1936.

THE BULLETIN

of

The American Association of Industrial Physicians and Surgeons

THE object of this Association shall be to foster the study and discussion of the problems peculiar to the practice of industrial medicine and surgery; to develop methods adapted to the conservation of health among workers in the industries; to promote a more general understanding of the purposes and results of the medical care of employees, and to unite into one organization members of the medical profession specializing in industrial medicine and surgery for the mutual advancement in the practice of their profession.

VOLNEY S. CHENEY, M.D.
Secretary-Treasurer, Chicago

PUBLICATION COMMITTEE

W. A. SAWYER, M.D.
Rochester, New York

L. A. SHOUDY, M.D.
Bethlehem, Pennsylvania

J. ROLLIN FRENCH, M.D.
Los Angeles, California

T. R. CROWDER, M.D.
Chicago, Illinois

E. C. HOLMBLAD, M.D.
Chicago, Illinois

OFFICERS

President: DR. FLOYD E. SHAFFER,
Bethlehem Steel Company,
Sparrows Point, Md.

President-Elect: DR. ROBERT P. KNAPP,
Cheney Brothers,
South Manchester, Conn.

1st Vice-Pres.: DR. SAMUEL R. BENEDICT,
Alabama Power Company,
Birmingham, Ala.

2nd Vice-Pres.: DR. DONALD GUTHRIE,
Lehigh Valley Railway, Sayre, Pa.

Sec'y-Treas.: DR. VOLNEY S. CHENEY,
Armour and Company, Chicago, Ill.

DIRECTORS

1935-1937

DR. EDWARD C. HOLMBLAD,
Railway Express Agency,
Chicago, Ill.

DR. CASSIUS H. WATSON,
American Telephone & Telegraph Co., New York, N.Y.

DR. ALFRED H. WHITTAKER,
Insurance Companies, Detroit, Mich.

DR. McIVOR WOODY,
Standard Oil Company,
New York, N. Y.

DR. ANDREW M. HARVEY,
Crane Company, Chicago, Ill.

DR. DANIEL L. LYNCH,
New England Telephone & Telegraph Co., Boston, Mass.

1934-1936

DR. DON B. LOWE,
B. F. Goodrich Company,
Akron, Ohio

DR. A. GIRARD CRANCH,
National Carbon Company,
Cleveland, Ohio

DR. ROYD R. SAYERS,
U. S. Public Health Service,
Washington, D. C.

DR. LOYAL A. SHOUDY,
Bethlehem Steel Company,
Bethlehem, Pa.

DR. WILLIAM A. SAWYER,
Eastman Kodak Company,
Rochester, N. Y.

The 1936 ANNUAL MEETING of the American Association of Industrial Physicians and Surgeons will be held in Atlantic City, New Jersey, on October 5 and 6. Headquarters will be at the Traymore Hotel. This will be at the same time and place as the Annual Meeting of the National Safety Council, of which one of the Fellows of the American Association of Industrial Physicians and Surgeons, Dr. Cassius H. Watson, is President.

is a comparatively slow process at any time. The arsenic is taken up by the roots of the hair, where it is fixed, and, as the hair grows, any of the metal that has been absorbed grows out with it. They believe that the only logical answer to the increased amount of arsenic in the hair is that the food which we eat today contains more arsenic than was formerly present in food. Remington has noted that the arsenic of the body is usually attributable to food, because of (1) chemical treatment in manufacture; (2) absorption by plants from the soil; (3) presence in sea food, and (4) the widespread use of arsenical sprays in America. Headden found that our virgin soils contain from two and one-half to five parts per million of arsenic and the underlying marl from four to 15 parts, and that the crops grown on such soils, and the animals fed on these crops, contain arsenic. The arsenic content of American cod liver oil offers some startling information. Holmes and Remington in their examination of 20 examples, comprising six geographic types, found very high amounts of arsenic. The average arsenic content of the oils is calculated to the trioxide and was found from 1.8 to 4.4 parts per million. The examination of human bone in poisoning cases showed that, when the individual lived only a few hours, the amount in the bone was quite small, whereas the bone of patients who had lived several days shows a substantial quantity of arsenic. A study of the bones of food animals, purchased at a market, showed quite high figures, particularly the bones of beef cattle. Two popular pipe tobaccos and two well known cigaret tobaccos were examined and it was found that tobacco (pipe) A contained 13.3; tobacco (pipe) B, 9.5; tobacco (cigaret) C, 11; and tobacco (cigaret) D, nine parts of arsenic per million.

Girls Entering Industry

THE factory girl starts her working life at the age of 14.* Those of us who look back to her own immaturity at that age, mental and physical, cannot fail to be shocked at the idea of anyone in a similar position being thrown into the hurly-burly of factory life. When we realize that many of these factory girls do not weigh more than five stone, that their monthly periods have not yet started, that some of them still think babies are brought to the family in the doctor's bag, our sense of shock is increased. Then if we consider that they may have an hour's journey to get to work and an hour back in the evening, and that at any moment they are liable, with overtime, to be asked to work twelve hours a day with only an hour and 20 minutes off during that time, we shall soon be driven to realize that it might be advisable to raise the school-leaving age from the doctor's point of view, apart from other considerations.

But something can be done for these children who have suddenly been plunged from the easy irresponsible life of a schoolgirl into the grim adult field of working for their living, to give them a rudimentary idea of elementary hygiene principles.

To start with, the matter of clothes is important. The workers tend to wear too much in the way of clothes, especially in factories where the temperature is kept constant all through the year. Too many clothes cause discomfort and decrease efficiency.

From clothes I usually go to the question of care of the hair and head. The last thing that one wants is some fierce nurse condemning girls for having nits in their hair. This wretched attitude, adopted in the past by hundreds of school teachers and nurses, has led to a state whereby merely to mention nits to a girl is to get a reaction of tears and shame accompanied by fierce abuse and denial. In the conditions in which workers have to live to-day and the crowded state of trams and trains, it is inevitable that they will pick up lice and nits sometimes. It is not necessarily any discredit to them at

* From "The Doctor's Point of View," by T. O. GARLAND, M.B., B.Ch., D.P.H., in *Labour Management*, May, 1936.

all, but this danger of infection should be pointed out, and they should be taught means of ridding themselves and given an elementary course in parasitology, if it only consists of telling them that nits are the eggs of lice.

Now I come to a matter that I think is very important, namely, the menace of patent medicines to the worker. Of 200 girls that I examined in 1934 between the ages of 14 and 16, and inquired in detail into their defaecation habits, only two gave any indication of being in the slightest degree constipated. The vast majority defaecated not just once but two or three times a day; yet 91 of them were taking aperients regularly, and of the other 109 many took them occasionally. Dr. A. F. Hurst has shown long ago, beyond all contention, what a pernicious influence aperients have on the normal action of the bowels, but the big guns of the patent medicine vendors have completely outshelled him.

But the aperient is only one of many cures and treatments that are offered in magazines, placards and posters to the ignorant worker. The extent of this propaganda is not realized until one definitely sets out on a walk along a shopping centre to count the advertisements claiming to cure various illnesses, or travels in the tube train with the same idea, or goes through the covers of the popular magazines. The vast majority of these claims are obviously quite impossible of fulfilment, but there are many growing rich on poor ignorant people who do not know this. I think it is the duty of a medical officer of a factory to warn his workers not to spend their wages in this fashion.

The most important thing of all to talk about to adolescent girls is their monthly periods. Of the 200 girls previously mentioned, aged 14 to 16, 54 had not started their periods. About half a dozen of the 54 had not even the foggiest conception of what a period was; yet at any moment one day at work they might find themselves mentruating, and suffer the severe mental shock that such an occurrence will produce when all knowledge of its nature is absent. Nine out of ten girls get what little knowledge they possess from scrappy talk among their schoolmates. It is of the hole-in-the-corner, naughty, dirty type, and is the worst possible way of acquiring knowledge. Nevertheless, knowledge acquired in this fashion is definitely better than none at all; unfortunately girls tend to dwell chiefly on the hair-raising side of the matter, of the terrible pains they will suffer, of how you will go mad if you don't start them before 18, and so on. One girl I treated thought she would go mad if her periods didn't start before 13, because her best friend at school had started at that age! The age of the supposed onset of lunacy varies, but 21 is the commonest in my experience.

I recommend that a short talk should be given to new workers collectively, after making certain that individually they do know what a period means: the talk explaining that menstruation is a natural function, and no cause for worry or fear, and trying to remove some of the superstitions above-mentioned — as well as the superstition that it is dangerous to bathe—or even to wash extensively—during the period.

This whole question is an extremely important one, because there is a great deal of absenteeism among working girls from menstrual upsets. If you go into this in detail, these upsets are hardly ever present in the first year or two of menstruation; they practically always come on a year or two later—in most girls, therefore, about the ages of 17 or 18. If a proper contact is made with the girls at the time when they are just starting, much of this lost time will be prevented. Personally, I am quite certain that the bulk of menstrual pain, vomiting, headaches, bad temper, excessive loss, etc., represent what one might call the physical externalisation of the problem that we all have to face of adjustment to the sex side of life. That is why these phenomena are rarely present when a period first starts. At 14 it is not a big problem, but at 17 or 18 when the girl is an attractive young woman, it is a very real one. What is there to be said for the attitude that offers the adolescent no helping hand over this difficult stile? The most savage African tribes stage elaborate initiation ceremonies for the purpose; but modern society allows the masses to blunder over it, and often they get so damaged and bruised in the process that they are permanently incapacitated.

It is as well to point out that the period of adolescence carries with it a physiological tax on a girl's strength, and that she should do what she can to cater for this. For those who are under weight it is worth something to encourage the eating of breakfast. It is most unusual for the working girl to have anything more than a piece of bread and butter to eat before she turns out to catch her bus or train, and many do not take even that. They often tell me that if they attempt to swallow anything it only "makes me 'eave," but it is worth trying to encourage them to take something.

Also the desirability of sleep should be pointed out. No one wants their life to be "all work and sleep"—a phrase I have often had thrown at me—and one late night or two a week by way of relaxation is desirable. But girls who have to be up between six and seven every morning at the age of 14 should be in bed most days by nine. I usually stress the point sleep plays in making them beautiful, that a tired girl never looks pretty, and go from this to stress the importance of making themselves look as attractive as possible. Many people think there is no need to do this with girls; although, happily, with many of them this is true, there are still a number, incredible though it may seem, who think it wicked even to powder their nose. A word from the doctor to counteract a calvinistic doctrine of this nature in the home circle may easily save a severe neurosis later.

Lastly, girls must be encouraged at the earliest possible date to broaden their interests. They must not just come from home to factory and back again home. Tell them to talk as little about work as they can outside working-hours. Work isn't the be-all and end-all of life—there are other things that matter; and tell them that their work problems, though they may seem all-important, must not obtrude themselves to the exclusion of outside interests, hobbies, amusements, etc. This point may be considered emphasized with advantage.

Back to Work

UNLESS we profit by past emergencies and make preparations for the resumption of normal times, I am afraid that the new order of things will prove costly to management in both man power and money.* Those things which seemed sufficient for successful employee and public relations in the past will not quite fit the changed conditions before us. We must realize that those millions returning to gainful occupation after a long period of unemployment, with its attendant sacrifices and worries, will have undergone decided changes in mind and body.

Those who are concerned with accident prevention in industry will have a man-size job on their hands. Where in the past the story of safety has been carried to the employee through mass education, in the future we must individualize the worker and convey our instruction by personal contact. Each man differs from his brother, and a different method of approach is essential.

What types of employees will be available to industry on the resumption of normal activity? What is the nature of the material that the safety engineer and his staff will have to deal with?

Those employees who have been retained during the depression to maintain a skeleton force constitute the first group. These men will be advanced in years but they are the backbone of the company. Around them we must build up the new personnel. During the years of depression they have had employment but their work has been increased by taking over added duties. Their responsibilities have become greater and this has taken a toll of their mental and physical reserves. With business recovery we will need these men more than ever. Will we find them able to carry on? Recently some of my good friends have passed on from causes traceable, I believe, to the pressure under which they were working.

Are we directing our attention now toward safeguarding these employees by helping them to conserve their efforts? Perhaps a well devised vacation would help to restore some of their reserves.

The second class includes those formerly employed by the company. They have been unemployed from one to six years. They have become older and at the same time their skill has suffered from lack of daily application. Their spirits have been dampened by economic insecurity. Will they be as safe workers as before? Mentally and physically, they have developed defects that are likely to show up under stress. Their sense of discipline has suffered, and this will be reflected in the early months of reemployment. They may have built up a fear complex, and

* Hart E. Fisher, M.D., F.A.C.S., Chief Surgeon, Chicago Rapid Transit Company; Vice-President for Health, National Safety Council, in *Nat. Safety News*, January, 1936, and *Rehabilitation Rev.*, January-February, 1936.

AMERICAN ASSOCIATION
of
RAILWAY SURGEONS

1935 - 1936

Officers

President ..... DON DEAL, M.D., Springfield, Ill.
Vice-President ..... W. A. MCMILLAN, M.D. Charleston, W. Va.
M. A. TINLEY, M.D., Council Bluffs, Iowa
H. A. BRENNECKE, M.D., Aurora, Ill.
Treasurer ..... S. C. PLUMMER, M.D., Chicago, Ill.
Secretary ..... D. B. MOSS, M.D., Chicago, Ill.
(Phone WABash 2345)

Executive Board

S. C. PLUMMER, M.D. ..... Chicago, Ill., *Chairman*
S. B. TAYLOR, M.D. ..... Columbus, Ohio
W. L. HARTMANN, M.D. ..... Detroit, Mich.
J. R. GARNER, M.D. ..... Atlanta, Ga.
G. G. DOWDALL, M.D. ..... Chicago, Ill.
JOHN R. NILLSSON, M.D. ..... Omaha, Nebr.

ASSOCIATION OF SURGEONS
of the
NEW YORK CENTRAL SYSTEM

OFFICERS

President:
W. H. MCNEILL, JR., M.D.

Vice-Presidents:
G. P. MYERS, M.D.
H. A. BALDWIN, M.D.
R. W. COTTON, M.D.
E. P. HAYDEN, M.D.

Secretary-Treasurer:
H. A. FATHAUER

Office of Secretary-Treasurer
413 LaSalle Street Station,
Chicago, Illinois.
Telephone WABash 4200

EXECUTIVE COMMITTEE

B. L. COLEY, M.D.. F.A.C.S.
Chief Surgeon, New York City.
L. A. ENSMINGER, M.D., F.A.C.S.
Chief Surgeon, Indianapolis.
H. A. FATHAUER,
Secretary-Treasurer
W. L. HARTMAN, M.D., F.A.C.S.
Medical Director, Detroit.
W. H. MCNEILL, JR., M.D., F.A.C.S.
President.
F. E. PIERCE, M.D., F.A.C.S.
Chief Surgeon, Chicago.
S. B. TAYLOR, M.D., F.A.C.S.
Chief Surgeon, Columbus.
G. R. WINTERS, M.D., F.A.C.S.
Chief Surgeon, Pittsburgh.

FRANK V. WHITING, General Claims Attorney

fear does not make for orderly work performance. Many believe that industry is responsible for their unemployment, and this belief has been strengthened by the continuous attacks on industry by political theorists.

In the third group we find the potential workers—those who never before have had steady occupation. These young men and women have left school or college since the onset of the depression. It is to this group that we look for new blood and spirit for the future. These young people, numbering hundreds of thousands, want to work. They emerge from school with ambitions high but enforced idleness has dampened their spirits and convinced them that education is a mockery. It will be difficult to adjust them to the routine and discipline of industrial life. These youngsters, who should be the backbone of business, have been handicapped.

One daily hears the statement that "the good old days are gone, never to return; life will be different in the future." Such statements come from middle age and old age. Young people bring youth into the nation's affairs. Their ambitions and hopes, if not blunted, will soon restore confidence. They will make their own good times."

The fourth group of prospective employees is made up of the chronically unemployed. Their numbers have increased greatly during the depression. These people work as little as possible. They believe that the world owes them a living. In this group we find many of radical tendencies. They are easily led by trouble makers and incited to mischief. They are not capable of thinking for themselves. Not all are radicals, of course; many desire only moderate contentment without responsibility. Some rove from place to place.

To these chronically unemployed we must add a new class which, prior to the depression, wanted gainful occupation. But long years of idleness have killed their will to work. They would rather remain on government dole than accept remunerative work. In this group the alien part of our population outnumbers the native born.

The sixth group of applicants comprises the old age group. They represent many years of useful occupation and will be a real asset to industry if they are given a chance to apply themselves.

Some may say that many in this group have become too old and have physical defects that will be hazardous in employment. But by proper placement, job analysis and medical supervision they can be maintained at useful work for many more years. I am talking not from theory but from 23 years of contact with transportation employees.

There is one group of willing employees that is practically barred from industry through fear of the compensation laws. I refer to those who are crippled or have one or more defects. Placement of this group in work that will fit their condition will return to the industry many a loyal and efficient employee. Many can be trained to new tasks within their powers. In all my experience I have never known an unfair award by the compensation boards to an employee with a deformity who had received an injury.

What will be the physical condition and mental caliber of these groups? All of them have undergone varying degrees of hardship during the past six years. Their troubled minds have received constant shocks. When men can see no relief for an economic situation, their hopes become deadened. Repeated disappointments lead to disillusionment and loss of confidence in those in authority. A suspicion complex is developed, and when you add to their confused state of mind the propaganda of self-seeking leaders, they look to anyone for relief as long as some action is forthcoming.

Thwarted ambitions and suppressed desires are especially unfortunate for the young people, because they are in the formative period. They will carry these emotional build-ups for a long time, and in many cases the effect will be permanent.

Suspicion and resentment must be allayed and an honest effort directed toward building up confidence in the working personnel. Some will be loath to accept the practices and plans formerly called welfare or industrial relations. Industry must lay its cards on the table, for industrial strife can be avoided and good employee relations can be built up by no other procedure.

During the past six years we have been remarkably free from epidemic diseases, but when the reaction sets in we may find individual vitality and reserve forces so depleted that disease may assume serious proportions. Many diseases and physical defects will be traced back to the depression years.

Twenty-three years of experience have convinced me that accidents are due to the following factors, and what is said for the transportation

OFFICERS

CHAIRMAN OF THE BOARD: LEROY P. KUHN, M.D., F.A.C.S., 4750 Sheridan Road, Chicago.

PRESIDENT: WILLIAM R. CUBBINS, M.D., F.A.C.S., 29 East Madison St., Chicago.

VICE-PRESIDENT: EDSON B. FOWLER, M.D., F.A.C.S., 1823 Hinman Ave., Evanston.

SECRETARY-TREASURER: JOHN D. ELLIS, M.D., F.A.C.S., 122 S. Michigan Ave., Chicago.

industry applies also to other industries:

1. **Mental limitation.** The lack of capacity for orderly thought. As the brain directs our actions, it will be seen that, should the mind be limited, the functions performed by our responsive actions may be incomplete or disrupted, and so precipitate an accident. Training and experience usually broaden mental capacity for orderly thought and performance. Should the individual's capacity be limited he will be unable to understand fully the safety plan. Lack of training makes doubly for accident proneness.

2. **Inability to visualize a potential accident hazard.** The poor safety records of some companies may be traced to this lack of visualization on the part of safety engineers and supervisors. They wait for accident occurrences before instituting safety measures. If the safety man cannot forsee accident potentialities, how can we expect the workers to exercise caution?

3. **Lack of ability to judge speed and distance**. This occurs within our ocular mechanism. We may have monocular or one-eyed vision instead of the normal binocular or steroscopic vision. This condition may be unknown to the worker and to the medical examiner.

4. **Limitation of the normal fields of vision.** These persons may have narrowed fields of vision, or telescopic sight. Acuity of vision may be normal but the individual will be unable to see objects at right angle to the eye. Many do not know they have this condition which is conducive to accidents in operating motor vehicles and working around moving machinery.

5. **Reaction time.** A person may see or hear an accident possibility and before he can bring his muscular forces into performance the accident has caught up with him. There are three forms of stimulation—visual, auditory and tactile. The period it takes for a person to react after stimulation is called reaction time. If this reaction time is delayed, either through normally slow performance or through distraction or illness, the hesitation may produce an accident. The methods used for measuring reaction time are standardized.

6. **Physical defects.** Defects and diseases cannot always be detected by superficial medical inspection. Their detection can be made only through clinical examination, including x-ray, laboratory tests of blood and urine, the Wassermann test, cardiographic records, metabolism tests, and blood pressure examination. A less thorough examination fails to detect the accident prone and gives a false sense of security to both the worker and his employer.

Should defects be found that make a man a hazard at his work, he should be placed at work within his limitations. Do not junk human material, conserve it. With a little patience and effort, the defective man can be fitted into the organization, and he will be able to carry on for many years in useful activity.

Let me refer again to the hazard of mental distraction which has received scant attention in industry. The safest and most efficient work is produced in an environment where disturbing elements are absent. Distracting noises may cause a work error or precipitate an accident. Scences through open windows tend to distract attention. Hurry and fault-finding foreman are distractions.

Then we have the element of climate. When the worker is too hot or too cold he is in danger. These conditions distract the mind, sap vitality and induce fatigue.

Disturbing thoughts caused by anger, grief, worry, envy, hate, greed, jealousy, disappointment and the like may be directly accountable for destroying the orderly processes of thought and submerging them in these powerful emotions. These emotions are known to alter the fluids of the body, suppress or stimulate glandular action, and work havoc with the nervous mechanism. Some of us are so constituted mentally that we can carry on safely and efficiently even in the face of such disturbing elements, but there are many less fortunate.

If, in addition to a disturbed state of mind, the employee has a body tormented by the pain or discomfort of sickness, he is apt to come to grief earlier, and the results of his accident will be more serious. When a man is sick in mind and body, the scene is set for an accident. Where health and a calm mind exist in an environment of comfort, we have the safety man's dream.

How, then, can we protect both employee and employer?

We must plan a broader employment selection. We must consider the mental states of those returning to industry. We should change the age limit for the new employee, permitting older men to find work and encouraging the young recruit to take up gainful occupation in a safe manner. It is essential that there be greater personal contact between management and employee, and a better understanding of each other's problems. The physical condition of those returning to work after prolonged unemployment must be carefully examined and the individual placed at work suited to his mental and physical qualifications. This means a medical policy far superior to that in vogue in the past, both as to equipment and personnel, and we should extend our study of preventing illness as well as accidents.

We must individualize the instruction to reach each employee and not rely on mass education. Fit the handicapped worker in the industrial niche that his physical condition will permit. Be more careful in introducing the employee to the work he is to perform. Let there be a more thorough interest and understanding by the supervisior of the problems of those under his direction. After employment we must consider maintenance of men from a physical standpoint and give the same care to their health as we give to our rolling stock and other property.

Employee health is so interwoven with efficient work and with safety that we must open our eyes to the necessity of aiding the employee to maintain himself as nearly in physical perfection as possible. It we fail now, government regulating bodies are quite likely to put forth plans for employee health and economic security.

Fraud!

THE first concerted offensive against fraud in workmen's compensation cases ever conducted in Manhattan has just been launched by the District Attorney's office in cooperation with the National Bureau of Casualty and Surety Underwriters and several State agencies.* In a series of articles, the Evening Journal exposes the nature and extent of these frauds, as well as those practiced in automobile and liability insurance.

At least 10,000 persons who have suffered little or no injury while at work are living on workmen's compensation payments in this city. That estimate is regarded as conservative by the Workmen's Compensation

* New York Evening Journal, April 27, 1936.

Bureau, the National Bureau of Casualty and Surety Underwriters, and by Assistant District Attorney Bernard Botein, who is directing the present drive to end racketeering in this field. The cost of this gigantic fraud, according to estimates from the same sources, runs into perhaps $5,000,000 annually.

The reasons why this racket has flourished, not for one year, but for at least 10, are principally these:

1. There has been scarcely any effort by prosecuting agencies to bring those who perpetrate the frauds to justice.

2. Insurance companies have been disinclined to fight the evil on an extensive scale because of the difficulties involved and the comparative smallness of most of the claims.

3. Doctors and lawyers, who are key figures in "rings" preying upon the compensation system are protected, to a considerable degree, by their professional standing — juries hesitate to convict them.

Those who make money out of the racket — the doctor, lawyer, claim representative, "runner" or, finally, the claimant—have this distinct advantage: For the city alone 113,253 accidents were "indexed" by the Workmen's Compensation Bureau in 1935. The number of accidents reported was 255,887. Those "indexed" were culled from the number reported and actually prepared for presentation to a referee. And the Bureau has no way of knowing which, of those thousands of cases prepared, are fraudulent from the outset or exaggerated out of all proportion to their seriousness. Approximately $20,000,000 was paid out in compensation claims in New York during 1935—an average of approximately $800 per claim for compensation and medical expenses. The unscrupulous find it fairly easly to turn this huge press of business in the bureau to their own purposes.

In the handling of this vast business only such investigation as insurance groups cared to make has stood in the way of fraud. Moreover, it has been the general practice of insurance companies, having discovered fraud in a particular compensation case, to accept a discontinuance of the claim or $1 settlement.

The attitude of the companies has changed drastically, however, in respect to all types of claims—compensation, automobile and liability — since the passage last June of a law permitting the claimant to select his own physician. Previously, the person claiming injury underwent treatment by a doctor designated by the insurance carrier or the employer. Fear that doctors, whose practice is not lucrative have been tempted to suggest to their patients that they ascribe injuries to accidents while at work, and thus collect compensation and medical costs, has spurred the companies to vigilance. Furthermore, surveys by the Underwriters Bureau have shown that although thousands of claims appear small on the face, the total of doctors' visits and other medical charges, as well as lost time payments, are enormous in the aggregate.

Those who profit most out of compensation frauds are the "rings." These generally consist of one or more doctors, several lawyers, "runners", claim agents, heads of business firms and foremen, and claimants. The "runner", or the doctor's business manager, if the physician is operating a clinic, makes contacts with employer and employees, persuading them to patronize a given doctor or clinic in the event of injury. Frequently this arrangement is collusive, the employee and employer consenting a falsification of the records—such as ascribing an accident which occurred at home to a hazard of employment and presenting false statements as to length of employment. Everyone involved splits the compensation award. The worker gets the smallest part. Fee splitting between the doctor, manager and "runner" is an essential feature of this type of racket. The

United States

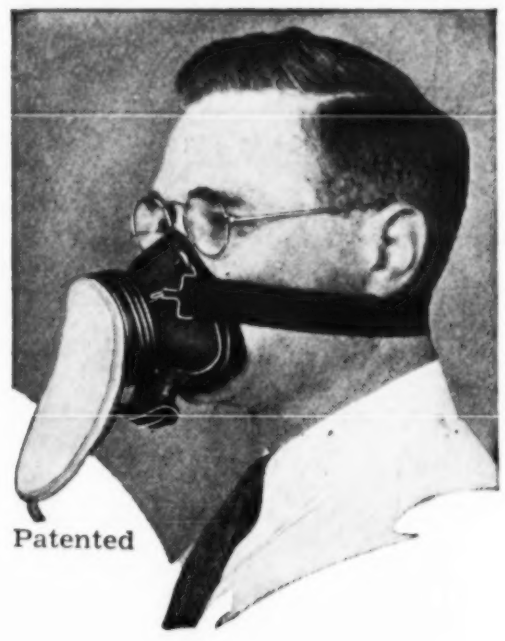
Bureau of Mines

approves

Willson No. 400L

Bag Respirator

for LEAD DUSTS



Patented

The Bureau of Mines has approved No. 400L "for protection against the inhalation of mechanically generated dusts whose main harmful constituent is lead, such as lead dusts generated in manufacturing storage batteries; enameling; pottery making; rubber compounding; sandpapering and chipping painted surfaces; paint making; preparing lithotransfers; and mining, milling and processing lead ores; and for protection against the inhalation of pneumoconiosis-producing or nuisance dusts, as quartz, asbestos, iron ores, cement, limestone, gypsum, coal, coke, charcoal, wood, cellulose, flour and aluminum."

The accumulated experience with bag respirators of our many good user friends plus the findings of our own Research Laboratories, have made the bag respirator for lead dusts possible. In back of everyone that leaves the plant is proof of worth built up by countless tests of materials and trials in various dust conditions in plants and factories of dozens of trades.

Sealed Air Passage
There is a sealed air passage between the filter bag and rubber face piece, making it impossible for even the finest dusts to gain entrance.

Low Breathing Resistance
Weighing only 5¼ ounces and having 40 square inches filtering area, these respirators are comfortable and very easy to breathe through.

Low Service Cost
Filter disc replacement problem is solved by the Approved Long Life Filters which in most cases last as long as the respirator.

Positive Action Intake Valve
Rebreathing of used air is prevented by an intake valve which closes automatically the moment exhalation starts.

WILLSON PRODUCTS, Inc.,

Reading, Pa.

Massachusetts Division of Occupational Hygiene

23 Joy Street, Boston

MANFRED BOWDITCH, A.B.....Director
HERVEY B. ELKINS, PH.D.....Chemist
EDWARD C. RILEY, M.SC. .....Engineer
LOUISE E. BURNHAM.....Senior Clerk
EVELYN BRONSKI.....Junior Clerk

"IT SHALL be the duty of the Division to investigate conditions of occupation with reference to hazards to health and to determine the degree of such hazards, to investigate and evaluate methods for the control of such hazards to assist in the preparation of rules and regulations for the preventing of occupational accidents and diseases, and, in cooperation with the department of public health or otherwise, to promote occupational health and safety education."—Sec. 11A of the law creating the Division, effective 1934.

The Association for the Advancement of Industrial Medicine and Surgery

Inc.

Executive Office - 370 Lexington Avenue, N. Y. (Room 904)

PURPOSE: *To disseminate accurate medical knowledge in reference to the diagnosis and treatment of all conditions arising out of and in the course of employment.*

OFFICERS

President:
ANTHONY AVATA, M. D.,
110 William St.,
New York City

Vice-President:
J. J. WITTMER, M.D.
4 Irving Place,
New York City

Recording Secretary:
DAVID SHAPIRO, M. D.
41 East 42nd St.,
New York City

Treasurer:
JOSEPH L. RAMIREZ, M. D.
30 Fifth Ave.,
New York City

Executive Secretary:
J. J. BLACKFORD, 370 Lexington Ave., New York City
(CAledonia 5-9753)
Robert F. Coleman, Inc.

EXECUTIVE COUNCIL

DR. J. HUDSON BLAUVELT	Fidelity & Casualty Insurance Co.
DR. T. WALLIS DAVIS	Borden Company
DR. LYLE ELLIS	Travelers Insurance Co.
DR. HALCYON HALSTEAD	Globe Insurance Co.
DR. BURKE C. HAMILTON	Aetna Life Insurance Co.
DR. GEORGE A. KOENIG	National Biscuit Co.
DR. WILLIS W. LASHER	Employers Liability Insurance Co.
DR. FREDERICK L. MOSSER	Third Ave. Ry. & Bus Lines
DR. ARTHUR R. TILTON	Travelers Insurance Co.

lawyers fight contested cases, and the claim representatives present the injured worker's story to a referee. They also pesent the doctor's records, which frequently lists visits never made and treatments not given. "Rings" of this character operate most successfully in the seasonable industries, particularly the garment industry. Records of the Compensation Bureau show that claims jump astonishingly as seasons draw to a close and workers face a period of unemployment. Claims also rise often shortly before business firms go into bankruptcy.

Medical Services for Municipal Employees

APPROXIMATELY 140,000 persons are regular employees in the various departments of the City government.* The greatest number are found in four departments, namely, the Department of Education, which employs 44,700; the Police Department, with 19,000 employees; the Sanitation Department, with 13,161; and the Fire Department, with 7,471 in its service.

There is no uniform regulation relative to sick leaves, compensation during illness and general supervision of sick employees. In many departments the employees receive fuli pay during illness; in others, half pay. Eleven City departments, with a total of about 24,000 employees, have no record whatever of the number of work days lost to the city on account of illness of employees. Due to lack of records of absences, to the lack of uniformity in paid sick leaves, and to the lack of adequate checkup on reported illness, the cost to the city of unrendered service due to illness, cannot be ascertained or even calculated with any approximation of accuracy. Judging, however, from the information obtained from some of the departments, this amount runs into many millions of dollars annually.

In the police and fire departments medical service has been provided through special legislation; it comprises many functions, including the care of the members of the force not only in illnesses or injuries incurred in the performance of duty, but in illnesses unrelated to their work. The department of sanitation likewise has a large medical staff to handle the various health problems of the force, except that injuries connected with their occupations come within the provisions of the workmen's compensation law.

The department of education has a small corps of physicians who examine candidates for admission to the service and pass on certain claims of the members of the teaching staff with regard to illness. Aside from this there is no official provision for health supervision of the personnel of the department.

In view of this the committee recommended that a Municipal Employees' Medical Service Bureau should be established to provide medical supervision of illnesses of all persons on the City payroll, except those employed in the departments of police, fire and sanitation. This bureau is not to provide medical treatment.

Under this plan, the medical divisions of the police, fire and sanitation departments would remain as at present, except that the facilities of thee borough clinics of the Municipal Employees' Medical Service Bureau would be available to them. The salaries of the medical employees of the police, fire and sanitation departments should be equalized on the basis of the type of service performed.

The proposed Municipal Employees' Medical Service Bureau would be in charge of an experienced medical director, responsible to the mayor or the budget director. On the basis of one physician to every 4,000 employees, the required medical personnel would be about 25 physicians, in addition to the director of the bureau. Eighteen are already available by transfer from other city departments. It was suggested that for the convenience of the employees and the physicians, a well equipped clinic should be established in each borough of the city, with an adequate clerical and nursing personnel. These clinics should be used by the medical division of the police, fire and sanitation departments for x-ray and laboratory services.

The absence from duty of every employee in the city service for reasons of illness would be reported to the bureau on the first day of absence by the secretary or chief clerk of the department concerned. The employees would be required to submit such evidence of disabling illness as the medical officers of the bureau may demand, and paid sickleave would be granted to an employee only on the basis of a report by the medical service bureau.

The committee further recommended that no sickleave pay be granted in illnesses of less than three days' duration and none during the first year of employment. Thereafter employees would be entitled to sickleave pay for two weeks for each year of service up to a maximum of 26 weeks in the 14th year. Employees earning $1500 or less per annum, on a full time basis, would receive two-thirds of their wages for the specified period of sickleave, and no one should receive less than $20 a week as sick pay. Above the basic rate of $1500 per annum, sick pay should be at the rate of two-thirds of $1500 plus one half the salary above this amount. This should not apply to cases of illness or disability coming under the provisions of the Workmen's Compensation Law.

Management of Head Injuries

MONEY considers the following pathologic conditions as being covered by the term "head injury":* (1) wounds and contusions of the scalp; (2) fractures of the skull and their complications; (3) meningeal and vascular injuries, leading to the various types of intracranial hemorrhage—epidural, subdural, subarachnoid and intracerebral; (4) contu-

* Committee on Public Health Relations, New York Academy of Medicine, Report of Activities for the Year 1935; *Bull. New York Acad. Med.*, April, 1936.

* *New England J. Med.*, 213:520, (September 12), 1935; Abstr. *J.A.M.A.*, 105: 1639, (November 16), 1935.

sions and lacerations of the brain, with edema and/or hemorrhage, leading to the clinical states of traumatic stupor and traumatic delirium (that is, concession, irritation and compression of the brain), and (5) after-effects of any of the foregoing, including mental deterioration, traumatic neurasthena and fits. A consideration of any large series of head injuries on the basis of traumatic stupor will enable them to be placed in three categories, according to their condition on admission to the hospital. The first group consists of patients who are deeply unconscious or comatose. These comprise chiefly cases of injury to the base of the skull with rapid and extensive subarachnoid hemorrhages and hemorrhages from the dural sinuses. The patient's condition becomes progressively worse, whatever is done, and death occurs within the first 24 hours and usually within the first eight hours. In the second group patients are of two main types. (1) Patients who have regained or are already regaining consciousness but are dazed and restless, with immediate retrograde amnesia. Provided a progressive return of the faculties proceeds, the prognosis is good, whatever the injury. (2) Patients who were primarily unconscious but have recovered and relapsed into a secondary unconsciousness or stupor. Unless careful observations have been made on admission or shortly afterward, it may be difficult to estimate the length of the lucid interval, the depth of this secondary stupor (the crucial point) and the existence of localizing signs. The classic cases of extradural and massive subdural hemorrhage fall into this group, and for them active operative intervention (subtemporal craniectomy, often bilateral) is essential. If the stupor is relatively light and no paralysis is observed, only edema may be present, and recovery will occur spontaneously or by the aid of dehydration methods without major operation. The third group consists of patients who are stuporous or lightly unconscious on admission and who remain uncooperative and unresponsive for hours, days or weeks. Despite this lack of cooperation, many useful observations and examinations can be made. The condition of the patients, thus revealed, is a gradual and progressive one toward recovery; anxiety will be relieved; and there is no need for major surgical intervention. These are usually cases of severer contusions and lacerations. The early adoption of the upright posture in a special bed is advocated, and the use of bromides and the barbiturates for restlessness in preference to morphine is urged. A routine is set out for the prevention and control of hyperthermia. The indications for lumbar puncture, both diagnostic and therapeutic, and the administration of hypertonic solutions are stated. The routine use of a simple spinal glass manometer to determine accurately the intracranial tension before deciding on active therapeutic measures is advised. The indications for and technic of operations for scalp wounds and fractures are considered in detail. The repair of defects in the cranial vault by bone grafts from the ilium is advocated. Failure of compensation and the onset of compression call for operation. Subtemporal decompression is usually sufficient to enable evacuation of the clot. Early evacuation of localized intracerebral hemorrhage to prevent the onset of fits is advocated.

A RUPTURE SERVICE
For INDUSTRIAL PHYSICIANS in the CHICAGO AREA

Since 1897 the Brooks Appliance Company has specialized in the manufacture of trusses and abdominal supports for all types of reducible hernia as well as for post-operative conditions.

As an additional service the company now maintains well equipped fitting rooms in Chicago, staffed by a personnel thoroughly experienced in the fitting of appliances and supports.

This service has enjoyed the endorsement of many industrial physicians as well as those in general practice, as it is now possible for any doctor to send his patients for fittings—with or without prescription — with complete confidence that the patient will be fitted with the type and kind of support indicated by the condition.

Several of the largest industrial plants are now using this service with satisfaction to the physician in charge and to the employees he refers. Inquiry is invited from others. A full explanation of our service will be sent, together with catalog of appliances and garments.

BROOKS APPLIANCE CO.

Room 409 Kesner Bldg. 5 N. Wabash Ave.,

Chicago, Illinois

Traumatic Rupture of Diseased Appendix Compensable

THE employee, during the course of his employment, assisted two fellow employees in carrying a heavy beam up a steep incline. He slipped and fell to his knees and immediately complained of abdominal pain, which persisted and forced him to quit work. An abdominal operation performed about 33 hours after the accident disclosed a diseased appendix and peritonitis, with the abdomen "filled with pus." No perforation was located, but an extensive exploration was not done because of the patient's grave condition. The appendix was removed and drainage instituted, but the employee died seven days after the operation. The department of labor and industries denied the claim of the employee's wife for an industrial insurance pension under the workmen's compensation act of Washington, and, from a judgment of the superior court sustaining the department's disallowance, the claimant appealed to the Supreme Court of Washington.*

The operating physician stated the causes of death, in the death certificate, as follows: " . . . The remote cause of death, accidental injury . . . The immediate cause of death, peritonitis and infection causing obstruction also traumatic appendicitis . . ." An autopsy proved to be of little or no value in locating a possible perforation, because of the extent to which the peritonitis had progressed by the time of death and because the embalmer had removed the gas and fluid from the abdominal viscera. It seems to have been conceded that prior to the accident the employee had a painless chronic inflammation of his appendix. The operating surgeon testified that trauma may accelerate chronic appendicitis and cause a rupture or perforation of a weakened diseased appendix. He expressed definitely the opinion that the injury received was the real beginning of the condition which caused the death of the employee. While, the court said, the evidence was clear that the appendix was diseased and in the course of time would have ruptured without any external pressure, yet there was evidence that the rupture of the appendix was accelerated by the injury. In view of this evidence, said the court, a rule laid down in Shadbolt v. Department of Labor and Industries, 121 Wash. 409; 209 P. 683, applies:

"Even though the appendix was diseased and in course of time would have ruptured without any external pressure, if its rupture was accelerated by such pressure, this would constitute an injury."

In the opinion of the Supreme Court, the claimant sustained the burden of proof that the accident suffered by the employee caused or accelerated a rupture of the appendix or intestine and that his death resulted therefrom. The judgment was reversed, therefore, with direction to remand the case to the Department of Labor and Industries with instructions to allow the claim.

* *Thomas* v *Department of Labor and Industries*, (Wash.), 44 P. (2d), 765; *J.A.M.A.*, 105: 2100, December 20, 1935.

Page Mr. Ripley!

ANYONE who views with skepticism the story of the man who sawed off the limb between himself and the tree may ruminate over this case reported by the American Petroleum Institute:*

"A burner was squatting down on top of a 10,000 barrel tank and was

* From *O. I. C. Monitor*, published by the Industrial Commission of Ohio, Division of Safety & Hygiene, March, 1936.

Industrial Medicine
REG. U. S. PAT. OFF.

The Journal of **Occupational Diseases** and Traumatic Surgery *for* Physicians and Surgeons in Industry

Its Field: **The Medical Science, the Law, the Economics, and the Statistics of**

INDUSTRIAL MEDICINE *and* TRAUMATIC SURGERY

Industrial Hygiene
Occupational Diseases
Traumatic Surgery
Medical Departments
Medicolegal Relations
Workmen's Compensation

EDITORS:

James T. Case, M.D., F.A.C.S.	Chicago, Ill.
Volney S. Cheney, M.D., F.A.C.S.	Medical Director, Armour & Company
Geo. G. Davis, M.D., F.A.C.S.	Chief Surgeon, The United States Fuel Co.
Joseph Jordan Eller, M.D.	Dermatologist, New York City
Hart E. Fisher, M.D., F.A.C.S.	Chief Surgeon, Chicago Rapid Transit Co.
John G. Frost, M.D., F.A.C.S.	Chief Surgeon, Chicago & Eastern Illinois Ry. Co.
Otto P. Geier, M.D.,	Director Employee Service, Cincinnati Milling Machine Co.
LeRoy P. Kuhn, M.D., F.A.C.S.	Chief Surgeon, Lumbermens Mutual Casualty Co.
Willis W. Lasher, M.D., F.A.C.S.	Chief Surgeon, Employers Liability Assurance Corp.
Horace W. Porter, M.D.	Jackson, Mich.
Frederick W. Slobe, M.D., F.A.C.S.	Chicago, Ill.
Charles D. Squires, M.D.	Binghamton, N. Y.

CONSULTANT:

C. O. Sappington, M.D., Dr. P.H. — Consulting Industrial Hygienist, Chicago, Ill.

OFFICIAL PUBLICATION:

American Association of Industrial Physicians and Surgeons
American Association of Railway Surgeons
Association for Advancement of Industrial Medicine and Surgery
Association of Surgeons of the New York Central System
Central States Society of Industrial Medicine and Surgery
Chicago Society of Industrial Medicine and Surgery
Institute of Traumatic Surgery
Michigan Association of Industrial Physicians and Surgeons
New York State Society of Industrial Medicine

A MEDICAL MAGAZINE—PROFESSIONALLY EDITED

(Conforming, in its advertising, to the standards of the Council on Pharmacy and Chemistry of the A. M. A.)

Published Monthly

Industrial Medicine
Reg. U. S. Pat. Off.

Subscription
$5.00 per year
2 Years for $9.00

844 Rush Street, Chicago, Illinois

burning a sheet from the roof. He burned the sheet around himself and before he realized it the sheet broke through and he fell inside the tank and was seriously injured."

"While Mentally Touring" is the very appropriate heading for this item. Manifestly, the victim's mind was somewhere other than at the scene of the accident.

Silicosis

CURTIS operated a rock crushing machine for the Allen Gravel Company from April 1 to November, 1930. During the dry times large quantities of dust were created by the crushing of the rock, and employees who worked around this machine had their eyes, mouths, and noses affected thereby. After Curtis had been working there a few months he developed a cough and experienced pains in the chest. He finally procured medical attention and abandoned the particular employment. However, he gradually grew worse, and the physician diagnosed his condition as tuberculosis brought on by silicosis. Curtis sued his employer and obtained judgment, from which the employer appealed to the supreme Court of Mississippi.*

The rule is, said the court, that the employer must use reasonable care to provide a safe place for his employees to work. He is not an absolute insurer of the safety of the place, nor is he required to use the highest degree of care; but he should take reasonable precautions to make the place of work reasonably safe. The medical testimony, continued the court, was ample to show the dangers incident to the inhalation of silica dust and the general recognition of such dangers by the medical profession. The public is interested in the preservation of health, and when others engage in business for profit which is dangerous to the health of employees, reasonable care should be taken to minimize the dangers. The employer in this case, apparently, did not furnish his employees with respirators or other appliances to reduce the hazards incident to the employment. Where simple devices may be obtained, the court said, at a reasonable cost, the employer should procure them for the protection of his employees. While the employer does not have to use all the latest devices that may be obtainable, he should exercise care to make the place safe, using reasonable care as a standard. The jury was warranted, in the opinion of the court, in finding that there was negligence on the part of the employer. The judgment for the employee was therefore affirmed.

Apoplexy and Insanity Following Minor Injury of Hand

A WORKMAN, 55 years old, injured his hand slightly in the course of his employment.* He had a stroke of apoplexy within a few days thereafter and another stroke a few months later. Subsequently he became insane. A claim for compensation was filed with the workmen's compensation bureau, which the bureau rejected. The Court of Common Pleas, however, reversed the bureau's order. Thereupon the employer appealed to the Supreme Court of New Jersey.

The claim for compensation was based on the theory that an embolus originated in the injury of the hand,

* *Allen Gravel Co.* v *Curtis,* (Miss.), 161 So. 79; *J.A.M.A.*, 105: 1939, December 7, 1935.
* *J.A.M.A.*, 105: 1633, (November 16) 1935; *Hahne & Co.* v *Guenther,* (N. J.) 178A., 58.

The Industrial Doctor

OFFICIAL SECTION OF THE NEW YORK STATE SOCIETY OF INDUSTRIAL MEDICINE

Published under supervision of the Ways and Means Committee of the New York State Society of Industrial Medicine. Editorial office, F. E. Redmond, Managing Editor, 406 Root Building, Buffalo, N. Y. Articles appearing herein do not necessarily reflect the opinion or policy of this journal nor of the New York State Society of Industrial Medicine.

Editorial Board

B. J. SLATER, M.D.
E. T. WENTWORTH, M.D.
M. S. BLOOM, M.D.
EDW. S. MCDOWELL, M.D.
P. K. MENZIES, M.D.
A. R. GRANT, M.D.
RAYMOND C. ALMY, M.D.
PAUL B. JENKINS, M.D.
WILLIS C. TEMPLER, M.D.
CHAS. P. HUTCHINS, M.D.
A. M. DICKINSON, M.D.
CHAS. D. SQUIRES, M.D.
RICHARD S. FARR, M.D.
C. W. WOODALL, M.D.
FRANCIS J. RYAN, M.D.
M. W. STOFER, M.D.
D. C. O'CONNOR, M.D.
F. N. C. JERAULD, M.D.
E. MACD. STANTON, M.D.
E. A. VANDERVEER, M.D.
E. S. MCSWEENY, M.D.
W. D. WARD, M.D.

FRANK E. REDMOND, *Managing Editor*

The New York State Society of Industrial Medicine

OFFICERS

CHARLES W. WOODALL, M.D., *President*
WILLIS C. TEMPLER, M.D., *1st. Vice-President*
E. A. VANDERVEER, M. D., *2nd Vice-President*
RAYMOND C. ALMY, M.D., *Treasurer*
FRANK E. REDMOND, *Executive Secretary*

Directors

DR. RAYMOND C. ALMY, Auburn
Columbia Rope Co.
DR. A. R. GRANT, Utica
321 Genesee St.
DR. EDW. S. MCDOWELL, Plattsburg
Saranac Pulp Company
DR. E. S. MCSWEENEY, New York
New York Telephone Co.
DR. P. K. MENZIES, Syracuse
511 Medical Arts Bldg.
DR. CHAS. D. SQUIRES, Binghamton
28 Conklin Ave.
DR. WILLIS C. TEMPLER, Corning
Corning Glass Works
DR. BEVERLY L. VOSSBURGH, Schenectary
General Electric Co.
DR. WILLIAM D. WARD, Rochester
20 Grove Place
DR. C. W. WOODALL, Schenectady
146 Barrett St.
DR. C. P. HUTCHINS, Syracuse
Aetna Life Insurance Company
DR. FRANCIS J. RYAN, Syracuse
New York State Railways
DR. B. J. SLATER, Rochester
Eastman Kodak Company
DR. A. M. DICKINSON, Albany
New York Central R. R.
DR. EDW. T. WENTWORTH, Rochester
DR. M. W. STOFER, Norwich
Norwich Pharmacal Company
DR. M. S. BLOOM, Binghamton
Dunn & McCarthy
DR. E. MACD. STANTON, Schenectady
American Locomotive Company
DR. F. N. C. JERAULD, Niagara Falls
DR. DONALD C. O'CONNOR, Buffalo
International Railways
American Radiator Co.
DR. RICHARD S. FARR, Syracuse
Consulting Orthopedist

Behind Mercurochrome

(dibrom-oxymercuri-fluorescein-sodium)
H W & D *is a background of*

Precise manufacturing methods insuring uniformity

Controlled laboratory investigation

Chemical and biological control of each lot produced

Extensive clinical application

Thirteen years' acceptance by the Council of Pharmacy and Chemistry of the American Medical Association

ACCEPTED AMERICAN MEDICAL ASSN. Council on Pharmacy and Chemistry

A booklet summarizing the important reports on Mercurochrome and describing its various uses will be sent on request.

HYNSON, WESTCOTT & DUNNING, Inc., Baltimore

Central States Society of Industrial Medicine and Surgery

Official Proceedings

Editor: VOLNEY S. CHENEY, M.D.
FRANK P. HAMMOND, M.D.
Secretary-Treasurer

Associate Editors:
DON DEAL, M.D.
FRANK P. HAMMOND, M.D.

Officers

President, DR. GEO. L. APFELBACH, Chicago
Secy-Treasurer, DR. FRANK P. HAMMOND, Chicago

Board of Governors

1936

DR. RALPH M. CARTER.....Green Bay, Wis.
DR. FREDERICK W. SLOBE.....Chicago, Ill.
DR. FLINT BONDURANT.....Cairo, Ill.

1937

DR. JOHN J. GRANT.....Freeport, Ill.
DR. DON DEAL.....Springfield, Ill.
DR. J. B. MOORE.....Benton, Ill.

1938

DR. JAMES FINCH.....Champaign, Ill.
DR. F. J. OTIS.....Moline, Ill.
DR. W. E. WOLCOTT.....Des Moines, Ia.

Chicago Society of Industrial Medicine and Surgery

Officers and Board of Governors

President.....JOHN G. FROST
Vice-President.....FRANK E. SCHRAM
Secretary-Treasurer.....FRANK P. HAMMOND

Office: 6308 Cottage Grove Ave., Chicago, Illinois

Term Expiring 1938	Term Expiring 1937	Term Expiring 1936
O. W. REST	GEORGE L. APFELBACH	HUGH W. MULLINS
FREDERICK W. SLOBE	FRED G. CARLS	FELIX M. JANSEY
E. A. DEGENHARDT	JAMES A. VALENTINE	FRED M. MILLER

was thrown off into the blood stream, passed through a persistent congenital opening between the arterial and venous sides of the heart (patent foramen ovale), and lodged in the brain instead of in the lungs, where it normally would have lodged but for the abnormal opening. Medical testimony conceded that this was a possibility, but it showed that the workmen had arteriosclerosis, with involvement of the heart and kidneys, and that clinical examination failed to disclose a patent foramen ovale. When a man is 55 years of age, said the court, and shows all the symptoms of arteriosclerosis, with involvement of the heart and kidneys, it is more reasonable to accept the hypothesis that the apoplexy was the natural result of the progress of arteriosclerosis than that it was due to an embolus, thrown off from a slight wound of the hand, passing to the brain because of an alleged congenital defect, which occasionally occurs in children, who do not long survive, and is rare in adults.

Compensation, continued the court, is not allowable for injuries caused by the natural progress of a disease from which a workman is suffering. Accordingly, the judgment of the lower court was reversed and compensation denied.

Nervousness

NERVOUSNESS is not a disease, but a disorder.* It is not a disease of the nerves or brain or any other part of the body; not 'auto-intoxication,' not 'weakness of the nerves,' or exhaustion, or fatigue. Nor is it a perquisite of the idle rich . . . It is purely and simply the result of maladjustment on the part of an otherwise perfectly sound, essentially normal person, and it is both curable and avoidable . . . Our problem is the most hopeful of all, for we have the splendid prospect of complete cure, of absolute prevention of future failures of adjustment, of the maintenance of complete usefulness, of the saving of a vast amount of misery energy and talent; for we are dealing with good, sound, undamaged material, handicapped by mismanagement only."

*DR. AUSTIN FOX RIGGS, of the National Committee for Mental Hygiene.

CUMULATIVE INDEX

of Articles, etc., of Original Publication, in Industrial Medicine

(The December, 1936, number will include the complete index of Volume 5)

Volume 5—Year 1936

No. 1, January, 1936.....Pages 1-52
No. 2, February, 1936.....Pages 53-104
No. 3, March, 1936.....Pages 105-160
No. 4 April, 1936.....Pages 161-220

THE NURSE PLACEMENT SERVICE

Room 512x, 8 South Michigan Ave., Chicago

Nurses available for all types of industrial positions—First Aid, Office, X-Ray and Laboratory Technician, Physiotherapist, Stenographic, and Public Health (in cooperation with the Joint Vocational Service).

Blood Drip Transfusion, by C. A. KATHERMAN, M.D. 171
Cardiac Pathology:
Relation to Industry, by HAROLD M. F. BEHNEMANN, M.D..... 105
Central States Society:
Clinic, Jan. 15, 1936..... 21
Joint Meeting with Chicago Medical Society 26
Chicago Society:
Meeting March 25, 1936..... 162
Diseases:
Infections, as Vulnerating Forces under Workmen's Compensation Acts, by KURT GARVE, M.D..... 29
Occupational, by C. O. SAPPINGTON, M.D., Dr. P.H..... 70
Dusts, X-Ray Studies of, by VICTOR HICKS 173
Examinations:
Physical, of Employees..... 1
Physical (Editorial) 39
Fluids, Intravenous:
—in Shock Dehydration, Starvation, etc., by J. TATE MASON, M.D., F.A.C.S. 168
Fractures:
Ankle Joint, by F. D. DICKSON, M.D., F.A.C.S. 199
Metatarsal and Phalangeal, One Splint for all, by GEO. G. DAVIS, M.D., F.A.C.S. 8
—of the Os Calcis by W. W. LASHER, M.D., F.A.C.S. 175
—of the Pelvis, by PHILIP H. KREUSCHER, M.D., F.A.C.S..... 185
Hernia:
Injection Treatment of, by F. W. SLOBE, M.D., F.A.C.S..... 201
Hydrocele:
Treatment of by the Injection Method, by G. H. EWELL, M.D..... 195
Industrial Medicine:
Industrial Medical Trends (Editorial) 39
Infection:
As Vulnerating Force under Workmen's Compensation Acts, by KURT GARVE, M.D. 29
—Soft Tissues of the Hand in, by M. M. TAYLOR, M.D..... 187
Injuries:
—to the Knee, by W. R. CUBBINS, M.D., F.A.C.S. 166
Prevention of Disability, by G. L. APFELBACH, M.D. 2
Institute of Traumatic Surgery:
Clinic, March 13, 1936..... 129
Joint Meeting with Chicago Orthopedic Society 133
Nursing:
—Service for Industry, by JOANNA M. JOHNSON, R.N..... 183
Occupational Disease:
—Compensation Cost Data, by F. ROBERTSON JONES 179
Liability Insurance, Monetary Cost of, by CAREY P. McCORD, M.D..... 139
Pneumokoniosis:
The Problem in Industry, by GEO. G. DAVIS, M.D., F.A.C.S..... 26
—and Its Social Effects, by JAMES W. FERGUSON, M.D..... 31
Poisoning:
By Petroleum Distillates, by EMERY R. HAYHURST, M.D., Ph.D..... 53
Radiograms:
Identification of, by A. R. METZ, M.D., F.A.C.S. 166
Serum, Pooled Convalescent:
—Cases of Hemolytic Streptococcus Infection, by E. C. HOLMBLAD, M.D., F.A.C.S. 163
Torsion:
—of Undescended Testicle, by GEO. G. DAVIS, M.D., F.A.C.S..... 66
Traumatic Fakir, The, by FRANK P. HAMMOND, M.D., F.A.C.S..... 3
Who's Who in I. M. & S.:
Samuel Craig Plummer..... 193